SETTLEMENT, IDENTITY AND ENVIRONMENT: UNDERSTANDING
PROCESSES OF VEGETATION CHANGE ALONG THE WIND RIVER

by

Teresa Helene Cohn

A dissertation submitted in partial fulfillment
of the requirements for the degree

of

Doctor of Philosophy

in

Earth Sciences

MONTANA STATE UNIVERSITY
Bozeman, Montana

October 2010
APPROVAL

of a dissertation submitted by

Teresa Helene Cohn

This dissertation has been read by each member of the dissertation committee and has been found to be satisfactory regarding content, English usage, format, citation, bibliographic style, and consistency, and is ready for submission to the Division of Graduate Education.

Dr. William Wyckoff

Approved for the Department of Earth Sciences

Dr. Steve Custer

Approved for the Division of Graduate Education

Dr. Carl E. Fox
STATEMENT OF PERMISSION TO USE

In presenting this dissertation in partial fulfillment of the requirements for a doctoral degree at Montana State University, I agree that the Library shall make it available to borrowers under rules of the Library. I further agree that copying of this dissertation is allowable only for scholarly purposes, consistent with “fair use” as prescribed in the U.S. Copyright Law. Requests for extensive copying or reproduction of this dissertation should be referred to ProQuest Information and Learning, 300 North Zeeb Road, Ann Arbor, Michigan 48106, to whom I have granted “the exclusive right to reproduce and distribute my dissertation in and from microform along with the non-exclusive right to reproduce and distribute my abstract in any format in whole or in part.”

Teresa Helene Cohn

October, 2010
ACKNOWLEDGEMENTS

In gratitude, I wish to thank my committee members: Dr. William Wyckoff (chair), Dr. Lisa Graumlich, Dr. Joseph Ashley, Dr. Steve Custer, Dr. Mary Cloninger and Dr. Galina Malovichko. I am especially grateful to Dr. Wyckoff for his insights and interest in this work. Many others scholars have contributed to this project, including Dr. Mike Merigliano, Dr. Daniel Tinker, Dr. Tania Schoennagel, Beth Helmke, Dr. Elisabeth Swanson, Dr. Matt Rinella and the staff of several local, state and national archives. This work would not have been possible without the interviewees listed in Chapter 3, countless Basin residents and the approval of the Eastern Shoshone and Northern Arapaho tribes. Cheryl Williams has been an enormous help, as well as the Baldes family and Jolene Catron. I am thankful to The Big Sky Institute and the Center for Learning and Teaching in the West for supporting me as a fellow, as well as those who made fellowship work possible, including Gloria C’Bearing, Janell Thunder, Mark Roy, and the Arapaho Culture Center. I would particularly like to express my gratitude to the Redman family for their encouragement and friendship, Shasta and Avela Grenier, and the help of Katy Kroupa. Finally, I would like to thank my family for their enduring support, particularly my husband, Mark Wolfenden.

Funding for this research was provided by the National Science Foundation’s GK12 Program, MSU's Center for Learning and Teaching in the West (NSF Award #0119796), MSU’s Department of Earth Sciences, the Big Sky Institute, the Montana Water Center, and the Wyoming Nature Conservancy.
TABLE OF CONTENTS

1. CONCEPTUAL FRAMEWORK AND GEOGRAPHICAL CONTEXT .................. 1
   Introduction ........................................................................................................... 1
   Research Focus ..................................................................................................... 4
   Project Overview .................................................................................................. 5
   Chapter Outline .................................................................................................... 8
   Research Context ................................................................................................ 10
   Conceptual Framework ....................................................................................... 16
      Settlement Geography ....................................................................................... 16
      Place Identity .................................................................................................. 21
      Vegetative Change and Human-Environmental Relationships ..................... 23
   Conclusion ........................................................................................................... 26

2. THE ‘CRAZY QUILT’: SETTLEMENT AND ENVIRONMENT IN THE WIND
   RIVER BASIN 1868-2010 .................................................................................. 28
   Introduction .......................................................................................................... 28
   The Drawing of Lines and the Marking of Borders: 1868-1905 ....................... 30
      Boundaries and Legal Control ........................................................................ 30
      Population and Settlement Patterns ................................................................ 32
      Reservation Land Allotment ............................................................................ 36
      Allotment Policy in the Wind River Basin ...................................................... 37
   Land and Water Use ............................................................................................ 40
      Irrigating Indian Lands ..................................................................................... 40
      Irrigating the Arid Lands .................................................................................. 44
      Irrigation Potential in the Wind River Basin .................................................. 46
      The Reclamation Service, the Indian Office, and Indian Allotment .............. 49
      A Dynamic Environment .................................................................................. 50
   Bridges in a Divided Basin: 1906-1938 ............................................................. 54
      Boundaries and Legal Control ........................................................................ 55
      Population and Settlement Patterns ................................................................ 57
      North of the River ............................................................................................ 57
      The South Side of the River ............................................................................. 72
   Land and Water Use ............................................................................................ 77
      Indian Farming on the River's South Side ....................................................... 77
      Indian Ranching ............................................................................................... 82
      Ranching on the North Side of the River ......................................................... 84
      Farming the North Side of the River ............................................................... 87
      Trees to Ties ..................................................................................................... 89
      A Dynamic Environment .................................................................................. 92
   Sharing the Basin: 1939-1976 .......................................................................... 96
TABLE OF CONTENTS--CONTINUED

Boundaries and Legal Control .................................................................................................................. 98
Boysen Dam........................................................................................................................................ 100
Population and Settlement Patterns ....................................................................................................... 102
Land and Water Use ................................................................................................................................. 104
Extractive Industry ................................................................................................................................. 104
Agriculture ........................................................................................................................................... 106
Third Division Riverton Project ............................................................................................................. 107
The Wind River Irrigation Project .......................................................................................................... 110
A Dynamic Environment ......................................................................................................................... 113
Alteration of Flows ................................................................................................................................. 114
Vegetation ........................................................................................................................................... 117
Soils ....................................................................................................................................................... 120
"The Big Horns of a Dilemma": 1977-2010 ........................................................................................... 128
Boundaries and Legal Control ................................................................................................................ 128
Overview of Relevant Indian Water Law ............................................................................................... 130
Big Horn I ............................................................................................................................................... 131
Big Horn III ........................................................................................................................................... 133
Dissents ............................................................................................................................................... 135
Ongoing Litigation ................................................................................................................................. 137
Population and Settlement Patterns ...................................................................................................... 138
Land and Water Use .............................................................................................................................. 144
A Dynamic Environment ......................................................................................................................... 147
Stream Pulse ......................................................................................................................................... 147
Overgrazing .......................................................................................................................................... 148
Tie Drives ............................................................................................................................................. 149
Contamination ....................................................................................................................................... 150
Conclusion ............................................................................................................................................. 151
Geographies of Exclusion ....................................................................................................................... 153
Resource Based Capitalism ................................................................................................................... 158
Social and Environmental Change .......................................................................................................... 159

3. YOO-AH, DYN (THE WARM VALLEY, SHOSHONE), NIITIINE’ETII-NO’
(WHERE WE LIVE, ARAPAHO), THE WIND RIVER BASIN: THE ROLE
OF PERCEPTION IN ENVIRONMENTAL CHANGE ......................................................... 162

Part I: Perceptions of Vegetation Change in the Wind River Basin ...................................................... 170
Agricultural Practices ............................................................................................................................. 170
Cultural Geographies of Agriculture ..................................................................................................... 181
Perceptions of Agriculture: Should it Exist in the Wind River Basin? ................................................. 184
Perceptions of Culturally Significant Plants .......................................................................................... 185
Berry Bushes ......................................................................................................................................... 189
Riparian Trees and Shrubs ....................................................................................................................... 191
# TABLE OF CONTENTS--CONTINUED

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forbs and Wetland Plants</td>
<td>195</td>
</tr>
<tr>
<td>Declines in Culturally Significant Vegetation</td>
<td>198</td>
</tr>
<tr>
<td>Perceptions of Weeds</td>
<td>202</td>
</tr>
<tr>
<td>Perceptions of Weed Management</td>
<td>209</td>
</tr>
<tr>
<td>Part 2: Perceptions of Riparian Areas and a Century of Change</td>
<td>213</td>
</tr>
<tr>
<td>Climate</td>
<td>214</td>
</tr>
<tr>
<td>Irrigation</td>
<td>218</td>
</tr>
<tr>
<td>Tribal Game Code</td>
<td>221</td>
</tr>
<tr>
<td>Groundwater Contamination</td>
<td>224</td>
</tr>
<tr>
<td>Litigation</td>
<td>228</td>
</tr>
<tr>
<td>Land Use Change</td>
<td>234</td>
</tr>
<tr>
<td>Part 3: Perception and Environmental Change in the Wind River Basin</td>
<td>244</td>
</tr>
<tr>
<td>Perception and Culture, Geography, and Scale</td>
<td>245</td>
</tr>
<tr>
<td>Perceptions Reflect Moral Geographies</td>
<td>247</td>
</tr>
<tr>
<td>Mobile Nature and Rural Mutualism</td>
<td>249</td>
</tr>
<tr>
<td>Perception and Power</td>
<td>251</td>
</tr>
<tr>
<td>Pragmatic Adaptive Management and Resilience</td>
<td>254</td>
</tr>
<tr>
<td>4. ENVIRONMENT AND SETTLEMENT: ASSESSING FACTORS OF RIPARIAN CHANGE</td>
<td>256</td>
</tr>
<tr>
<td>Riparian Change along Western Rivers</td>
<td>258</td>
</tr>
<tr>
<td>Land Use Change Near Protected Areas</td>
<td>264</td>
</tr>
<tr>
<td>Study Area</td>
<td>269</td>
</tr>
<tr>
<td>Methods</td>
<td>272</td>
</tr>
<tr>
<td>Riparian Change</td>
<td>276</td>
</tr>
<tr>
<td>Urban and Rural Development</td>
<td>279</td>
</tr>
<tr>
<td>Results</td>
<td>280</td>
</tr>
<tr>
<td>Changes in Riparian Areas</td>
<td>280</td>
</tr>
<tr>
<td>Changes in Development</td>
<td>282</td>
</tr>
<tr>
<td>Discussion</td>
<td>284</td>
</tr>
<tr>
<td>Geographical Area 1</td>
<td>285</td>
</tr>
<tr>
<td>Geographical Area 2</td>
<td>300</td>
</tr>
<tr>
<td>Geographical Area 3</td>
<td>312</td>
</tr>
<tr>
<td>Geographical Area 4</td>
<td>329</td>
</tr>
<tr>
<td>Geographical Area 5</td>
<td>339</td>
</tr>
<tr>
<td>Summary of Geographical Areas</td>
<td>348</td>
</tr>
<tr>
<td>Conclusion</td>
<td>355</td>
</tr>
</tbody>
</table>
5. CONCLUSION

Three Lenses of Change.................................................................358
Historical Geography and Environmental Change..........................361
Perception and Environmental Change..........................................366
Historical Geography and Perception............................................370
Historical Geography, Place Perception, and Environmental Change:...372
Managing a River: The Wind River and Water in the West................373
New West Trends...........................................................................375

6. ADDENDUM: CLARIFICATION OF RESERVATION BOUNDARY AND
JURISDICTION OF LANDS NORTH OF THE WIND RIVER...............380

REFERENCES CITED........................................................................385
APPENDIX A: Interview Questions.................................................400
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>The Wind River.</td>
</tr>
<tr>
<td>1.2</td>
<td>The Greater Yellowstone Ecosystem (GYE) county area.</td>
</tr>
<tr>
<td>1.3</td>
<td>Study area.</td>
</tr>
<tr>
<td>1.4</td>
<td>Settlement corridor.</td>
</tr>
<tr>
<td>1.5</td>
<td>The Wind River Indian Reservation.</td>
</tr>
<tr>
<td>2.1</td>
<td>The Wind River descends from its headwaters.</td>
</tr>
<tr>
<td>2.2</td>
<td>Boundaries of the Shoshone Indian Reservation 1868-1906.</td>
</tr>
<tr>
<td>2.3</td>
<td>Arapaho and Shoshone settlement along the Little and Big Wind Rivers and their tributaries, 1886-1889.</td>
</tr>
<tr>
<td>2.4</td>
<td>Map of Shoshone Reservation communities, late 1800s to early 1900s.</td>
</tr>
<tr>
<td>2.5</td>
<td>Areas of Shoshone, Arapaho and Sioux allotment.</td>
</tr>
<tr>
<td>2.6</td>
<td>Map of proposed irrigation development, 1905-1906.</td>
</tr>
<tr>
<td>2.7</td>
<td>Cottonwood forests along the Wind River near Crowheart Butte.</td>
</tr>
<tr>
<td>2.8</td>
<td>The Wind River Diversion Dam bridge.</td>
</tr>
<tr>
<td>2.9</td>
<td>Shoshone Reservation boundaries, 1906.</td>
</tr>
<tr>
<td>2.10</td>
<td>Advertising map of ceded reservation lands, 1907.</td>
</tr>
<tr>
<td>2.11</td>
<td>The new towns of Shoshoni and Riverton.</td>
</tr>
<tr>
<td>2.12</td>
<td>Map of the Wind River drainage, 1917.</td>
</tr>
<tr>
<td>2.13</td>
<td>Three original units of the Riverton Project, 1917.</td>
</tr>
<tr>
<td>2.14</td>
<td>Riverton Project construction.</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.15</td>
<td>Construction of the Wind River Diversion Dam.</td>
<td>67</td>
</tr>
<tr>
<td>2.16</td>
<td>Map of irrigation canals.</td>
<td>68</td>
</tr>
<tr>
<td>2.17</td>
<td>Riverton Project homestead after one year of settlement.</td>
<td>69</td>
</tr>
<tr>
<td>2.18</td>
<td>Early croplands and hayfields.</td>
<td>70</td>
</tr>
<tr>
<td>2.19</td>
<td>Map of proposed Indian ditches.</td>
<td>76</td>
</tr>
<tr>
<td>2.20</td>
<td>Shoshone farmer.</td>
<td>78</td>
</tr>
<tr>
<td>2.21</td>
<td>A 4-H farm, young farmers, and extension agency workers.</td>
<td>82</td>
</tr>
<tr>
<td>2.22</td>
<td>Ranchers and sheep corrals.</td>
<td>84</td>
</tr>
<tr>
<td>2.23</td>
<td>Cattlemen run their herds in the Wind River Basin.</td>
<td>86</td>
</tr>
<tr>
<td>2.24</td>
<td>Sugar beets are prepared for shipment.</td>
<td>88</td>
</tr>
<tr>
<td>2.25</td>
<td>Wind River tie drives.</td>
<td>89</td>
</tr>
<tr>
<td>2.26</td>
<td>Railroad ties piled in Riverton ready for stacking and shipment.</td>
<td>91</td>
</tr>
<tr>
<td>2.27</td>
<td>Unexpected flooding and ice flows.</td>
<td>93</td>
</tr>
<tr>
<td>2.28</td>
<td>A truck sprays field bindweed in the Goggles allotment, 1953.</td>
<td>96</td>
</tr>
<tr>
<td>2.29</td>
<td>Map of lands returned in the Shoshone Judgment Act, 1939.</td>
<td>98</td>
</tr>
<tr>
<td>2.30</td>
<td>Bottomlands flooded by Boysen Dam.</td>
<td>101</td>
</tr>
<tr>
<td>2.31</td>
<td>Hydrograph of the Wind River, 1920s and 1960s.</td>
<td>115</td>
</tr>
<tr>
<td>2.32</td>
<td>Weed control.</td>
<td>119</td>
</tr>
<tr>
<td>2.33</td>
<td>Bank stabilization using limbs of trees.</td>
<td>123</td>
</tr>
<tr>
<td>2.34</td>
<td>Cars are used to stabilize banks on the Wind River.</td>
<td>125</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.35</td>
<td>Golden willow and Russian olive plantings, 1953.</td>
<td>126</td>
</tr>
<tr>
<td>2.36</td>
<td>Land use along the Wind River.</td>
<td>128</td>
</tr>
<tr>
<td>2.37</td>
<td>Changes in land use between 1948 and 2006.</td>
<td>140</td>
</tr>
<tr>
<td>2.38</td>
<td>Four settlement mosaics in the Wind River Basin.</td>
<td>141</td>
</tr>
<tr>
<td>2.39</td>
<td>Reservation boundaries and vegetation patterns, 2006.</td>
<td>142</td>
</tr>
<tr>
<td>2.40</td>
<td>Map depicts the complex ownership of the Wind River Basin.</td>
<td>143</td>
</tr>
<tr>
<td>2.41</td>
<td>Wind River hydrograph by decade.</td>
<td>148</td>
</tr>
<tr>
<td>3.1</td>
<td>Flora Dewey (Arapaho) takes a photograph of the Wind River Basin through her windshield.</td>
<td>162</td>
</tr>
<tr>
<td>3.2</td>
<td>Arapaho boys walk through a barn at the Arapaho Ranch.</td>
<td>170</td>
</tr>
<tr>
<td>3.3</td>
<td>A farmer whose land borders the river.</td>
<td>180</td>
</tr>
<tr>
<td>3.4</td>
<td>The Redman family collects medicinal roots.</td>
<td>186</td>
</tr>
<tr>
<td>3.5</td>
<td>Riparian area near Arapaho.</td>
<td>194</td>
</tr>
<tr>
<td>3.6</td>
<td>The Wind River south of Riverton.</td>
<td>213</td>
</tr>
<tr>
<td>3.7</td>
<td>High flow, 2005.</td>
<td>214</td>
</tr>
<tr>
<td>3.8</td>
<td>The Wyoming Canal diverts water to Riverton Project lands.</td>
<td>218</td>
</tr>
<tr>
<td>3.9</td>
<td>Pronghorn graze in a bluff next to the Wind River.</td>
<td>222</td>
</tr>
<tr>
<td>3.10</td>
<td>Bucks graze in a hayfield.</td>
<td>223</td>
</tr>
<tr>
<td>3.11</td>
<td>The Chem Trade Sulfuric Acid Plant, previously the Susquehanna Uranium Mill Processing Plant.</td>
<td>224</td>
</tr>
<tr>
<td>3.12</td>
<td>Relatively new house is perched on the northern bank of the highly mobile Wind River.</td>
<td>236</td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>3.13</td>
<td>Wyoming Land and Cattle Company pond next to the Wind River.</td>
<td>238</td>
</tr>
<tr>
<td>3.14</td>
<td>Expanse of undeveloped land in the Wind River Basin looking eastward toward Crowheart Butte.</td>
<td>244</td>
</tr>
<tr>
<td>4.1</td>
<td>The Wind River settlement corridor displays unique historical and cultural relationships.</td>
<td>256</td>
</tr>
<tr>
<td>4.2</td>
<td>The study area of this research</td>
<td>257</td>
</tr>
<tr>
<td>4.3</td>
<td>Geographical areas of the Wind River corridor.</td>
<td>272</td>
</tr>
<tr>
<td>4.4</td>
<td>Reference areas for assessing distortion.</td>
<td>273</td>
</tr>
<tr>
<td>4.5</td>
<td>Depiction of two study areas.</td>
<td>275</td>
</tr>
<tr>
<td>4.6</td>
<td>Vegetation polygons.</td>
<td>276</td>
</tr>
<tr>
<td>4.7</td>
<td>Point distribution.</td>
<td>277</td>
</tr>
<tr>
<td>4.8</td>
<td>Land ownership layer.</td>
<td>278</td>
</tr>
<tr>
<td>4.9</td>
<td>Analysis of number of buildings.</td>
<td>279</td>
</tr>
<tr>
<td>4.10</td>
<td>Forestation in different geographical regions.</td>
<td>281</td>
</tr>
<tr>
<td>4.11</td>
<td>Percent forest change as it relates to land ownership.</td>
<td>282</td>
</tr>
<tr>
<td>4.12</td>
<td>Changes in human structures.</td>
<td>283</td>
</tr>
<tr>
<td>4.13</td>
<td>Changes in structures as related to land ownership.</td>
<td>284</td>
</tr>
<tr>
<td>4.14</td>
<td>Location map of GA1 imagery.</td>
<td>285</td>
</tr>
<tr>
<td>4.15</td>
<td>GA1 change in riparian forest.</td>
<td>287</td>
</tr>
<tr>
<td>4.16</td>
<td>GA1 development change.</td>
<td>287</td>
</tr>
<tr>
<td>4.17</td>
<td>Wind River hydrograph, USGS Crowheart gage.</td>
<td>288</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.18 GA1 aerial photo pair 1.</td>
<td>292</td>
</tr>
<tr>
<td>4.19 GA1 aerial photo pair 2.</td>
<td>293</td>
</tr>
<tr>
<td>4.20 GA1 aerial photo pair 3.</td>
<td>294</td>
</tr>
<tr>
<td>4.21 GA1 repeat photo pair “a.”</td>
<td>295</td>
</tr>
<tr>
<td>4.22 GA1 repeat photo pair “b.”</td>
<td>296</td>
</tr>
<tr>
<td>4.23 GA1 repeat photo pair “c”</td>
<td>297</td>
</tr>
<tr>
<td>4.24 GA1 repeat photo pair “d”</td>
<td>298</td>
</tr>
<tr>
<td>4.25 July, 2009 photo of GA1 upstream of Crowheart</td>
<td>299</td>
</tr>
<tr>
<td>4.26 July, 2009 photo of riparian forest upstream of Crowheart</td>
<td>299</td>
</tr>
<tr>
<td>4.27 Location map of GA2 imagery</td>
<td>300</td>
</tr>
<tr>
<td>4.28 GA2 change in riparian forest</td>
<td>301</td>
</tr>
<tr>
<td>4.29 GA2 change in riparian forest with respect to land ownership</td>
<td>301</td>
</tr>
<tr>
<td>4.30 GA2 development change</td>
<td>302</td>
</tr>
<tr>
<td>4.31 GA2 development change with respect to land ownership</td>
<td>302</td>
</tr>
<tr>
<td>4.32 Kinnear gage hydrograph</td>
<td>304</td>
</tr>
<tr>
<td>4.33 Riverton hydrograph</td>
<td>304</td>
</tr>
<tr>
<td>4.34 GA2 aerial photo pair 1</td>
<td>305</td>
</tr>
<tr>
<td>4.35 GA2 aerial photo pair 2</td>
<td>306</td>
</tr>
<tr>
<td>4.36 GA2 aerial photo pair 3</td>
<td>307</td>
</tr>
<tr>
<td>4.37 GA2 aerial photo pair 4</td>
<td>308</td>
</tr>
</tbody>
</table>
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.38 GA3 repeat photo pair “a”</td>
<td>309</td>
</tr>
<tr>
<td>4.39 GA2 repeat photo pair “b”</td>
<td>310</td>
</tr>
<tr>
<td>4.40 GA2 repeat photo pair “c”</td>
<td>311</td>
</tr>
<tr>
<td>4.41 Location map of GA3 imagery</td>
<td>312</td>
</tr>
<tr>
<td>4.42 GA3 change in riparian forest</td>
<td>313</td>
</tr>
<tr>
<td>4.43 GA3 change in development</td>
<td>313</td>
</tr>
<tr>
<td>4.44 GA3 change in riparian forest with respect to development</td>
<td>314</td>
</tr>
<tr>
<td>4.45 Hydrograph of the USGS Riverton gage</td>
<td>315</td>
</tr>
<tr>
<td>4.46 GA3 change in development with respect to land ownership</td>
<td>316</td>
</tr>
<tr>
<td>4.47 GA3 aerial photo pair 1</td>
<td>318</td>
</tr>
<tr>
<td>4.48 GA3 aerial photo pair 2</td>
<td>319</td>
</tr>
<tr>
<td>4.49 GA3 aerial photo pair 3</td>
<td>320</td>
</tr>
<tr>
<td>4.50 GA3 aerial photo pair 4</td>
<td>321</td>
</tr>
<tr>
<td>4.51 GA3 aerial photo pair 5</td>
<td>322</td>
</tr>
<tr>
<td>4.52 GA3 aerial photo pair 6</td>
<td>323</td>
</tr>
<tr>
<td>4.53 GA3 aerial photo pair 7</td>
<td>324</td>
</tr>
<tr>
<td>4.54 GA3 aerial photo pair 8</td>
<td>325</td>
</tr>
<tr>
<td>4.55 GA3 repeat photo pair “a”</td>
<td>326</td>
</tr>
<tr>
<td>4.56 GA3 photo “b”</td>
<td>327</td>
</tr>
<tr>
<td>4.57 GA3 photo “c”</td>
<td>327</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.58</td>
<td>GA3 photo “d”</td>
</tr>
<tr>
<td>4.59</td>
<td>Location map of GA4 imagery</td>
</tr>
<tr>
<td>4.60</td>
<td>GA4 change in riparian forest</td>
</tr>
<tr>
<td>4.61</td>
<td>GA4 change in riparian forest with respect to land ownership</td>
</tr>
<tr>
<td>4.62</td>
<td>GA4 change in development</td>
</tr>
<tr>
<td>4.63</td>
<td>GA4 change in development with respect to ownership</td>
</tr>
<tr>
<td>4.64</td>
<td>GA4 aerial photo pair 1</td>
</tr>
<tr>
<td>4.65</td>
<td>2006 image from GA4 photo pair 1 depicted with ownership map</td>
</tr>
<tr>
<td>4.66</td>
<td>GA4 aerial photo pair 2</td>
</tr>
<tr>
<td>4.67</td>
<td>GA4 aerial photo pair 3</td>
</tr>
<tr>
<td>4.68</td>
<td>GA4 aerial photo pair 4</td>
</tr>
<tr>
<td>4.69</td>
<td>GA4 photograph “a”</td>
</tr>
<tr>
<td>4.70</td>
<td>GA4 photograph “b”</td>
</tr>
<tr>
<td>4.71</td>
<td>Location map of GA5 imagery</td>
</tr>
<tr>
<td>4.72</td>
<td>Aerial images of Boysen Dam area, 1948/49 and 2006</td>
</tr>
<tr>
<td>4.73</td>
<td>GA5 aerial photo pair 1</td>
</tr>
<tr>
<td>4.74</td>
<td>GA5 aerial photo pair 2</td>
</tr>
<tr>
<td>4.75</td>
<td>GA5 aerial photo pair 3</td>
</tr>
<tr>
<td>4.76</td>
<td>GA5 repeat photo pair “a”</td>
</tr>
<tr>
<td>4.77</td>
<td>GA5 repeat photo pair “b”</td>
</tr>
</tbody>
</table>
### LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.78 GA5 repeat photo pair “c”</td>
<td>347</td>
</tr>
<tr>
<td>4.79 Aerial photo pair of suburban development</td>
<td>349</td>
</tr>
<tr>
<td>4.80 Land ownership and its relationship to cultivated lands in GA4</td>
<td>351</td>
</tr>
<tr>
<td>4.81 Land ownership and cultivated lands in GA2</td>
<td>352</td>
</tr>
<tr>
<td>4.82 Development and land ownership in GA3</td>
<td>354</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Shoshone plant names</td>
<td>187</td>
</tr>
<tr>
<td>3.2 Arapaho plant names</td>
<td>188</td>
</tr>
<tr>
<td>4.1 Estimated imagery distortion in reference areas</td>
<td>274</td>
</tr>
</tbody>
</table>
ABSTRACT

Contemporary research concerning wildlands and wildlife of the American West increasingly calls for greater complexity in understanding human-environmental relationships. This dissertation investigates a culturally diverse portion of Greater Yellowstone in order to complicate these dialogues. It explores a riparian corridor along the Wind River, a region permanently settled by Eastern Shoshone, Northern Arapaho and Euro-American residents in the late 1800s and early 1900s. Using the Wind River Basin as a case study, this research observes the landscape through three different lenses: settlement geography, place identity, and vegetation change. By incorporating a variety of methods to understand regional change (including historical research, interviews with residents, and comparative aerial and ground photography), it finds that riparian change relates to a complex cultural-ecological mosaic. Not only is change perceived differently by a variety of communities in the Wind River Basin; change relates to century-old settlement geographies, government policies and cultural preferences, shifting economies and power relationships, and evolving relationships formed by interrelationships of people and environment. This dissertation argues that investigations of environmental change must not oversimplify dynamic relationships between people and place. Indeed, the complexity of these places may relate to why Greater Yellowstone has remained one of the largest intact ecosystems in the lower 48 states.
CHAPTER 1

CONCEPTUAL FRAMEWORK AND GEOGRAPHICAL CONTEXT

Figure 1.1 The Wind River. The Wind River meanders through its floodplain south of Riverton. Photo courtesy of the Wyoming State Archives.

Introduction

The Wind River (Figure 1.1) drains the southeastern portion of the Greater Yellowstone Ecosystem (GYE), an area referred to as the largest intact (or nearly intact) ecosystem in the lower 48 states by both scholarly and popular literature (Gosnell, Haggarty, and Travis 2006; Gude et al. 2006; Greater Yellowstone Coalition 2010). This “region of distinctive ecological significance” (Gosnell, Haggarty, and Travis 2006) that supports “some of the earth’s most cherished wildlands and wildlife” (Greater Yellowstone Coalition 2010) is often contrasted with concerns over the loss of this status. Land ownership change, immigration and rural development, damming and water diversion, and land fragmentation present well documented threats to its ecological integrity (Citizens of Madison County 1999; BBC Research and Consulting for the Upper
This discourse is critical to current planning concerns as it helps uncover regional trends and unravel their consequences; however, much of this discussion overlooks the extent of cultural diversity in the region, values and perceptions stemming from deep pasts, unfolding hegemonies and power dynamics, and the capacity for a complex history to shape regional ecology in heterogeneous ways. Nancy Langston (2003, 4) notes, “An ecosystem is a product of its history, and that history includes cultural as well as ecological forces.” As she suggests, more complicated histories may offer insights into better adaptive land and water management. More specifically, they may depict, through human-ecological interactions over time, how to better address the “moral economy” (Fiege 1999, 114) of land, water, and the diverse zone where they meet.

Tribal lands cover five percent of the GYE (Gude et al. 2006) which sounds more substantial when quantified as 2.3 million acres, or an area roughly the size of Yellowstone National Park (Figure 1.2). While this region supports cherished wildlife and wildlands similar to the rest of the GYE, its unique settlement history and land ownership regulations, water rights and water development, and cultural worldviews may create sharply different cultural and ecological trends than those of its Old West or New West neighbors.
This may be most evident in riparian areas, where plants “help to blur the boundaries between water and land” (Langston 2003, 15) both ecologically and socially. As riparian zones link various ecological processes and functions (Naiman and Decamps 1997; Knight 1994) they also connect historical and present landscapes, central places and their hinterlands, and, perhaps most importantly, cultural groups and class structures to one another. Western riparian areas are zones of rich ecological diversity as well as heightened human cooperation and conflict. Moreover, these ecological and social landscapes dynamically respond and adapt to one another in what Mark Fiege (1999) calls “hybrid landscapes” of human-ecological interactions.
This dissertation focuses on the Wind River's riparian landscape in order to highlight the way cultural and ecological forces shape this portion of the GYE. It suggests that other large ecosystems may be shaped in their own unique, but similar, mosaics. Through more complicated discourses we will better understand the role of ecosystem management within its own human-ecological framework, as one of many dynamics shaping ecosystems.

**Research Focus**

Ecologists, geographers, historians, and hydrologists have stressed that an integration of ecology and history will allow us to better recognize environmental complexity (Balée 1998; Swetnam, Allen, and Betancourt 1999; Naiman 1999; Wohl 2001; Langston 2003; Freeman, Stanley, and Turner 2003; Wohl 2005). By integrating historical geography and ecological analysis, this research investigates the following question: in a region of the GYE noted for its wildlands, wildlife and deep rooted cultural diversity, how do unique settlement geographies and place identities relate to environmental change and the way that change is perceived? This research addresses that question by 1) exploring the interaction between external economic drivers, government policies, and power dynamics with settlement patterns and cultural landscapes; recognizing the ways a combination of external forces and local agency contributes to heterogeneous riparian change, 2) considering the ways place identity differs between cultural groups and changes over time, how different perceptions influence the kind of
change perceived and the way change is valued, and 3) examining vegetation and land use change in Wind River riparian areas since 1905.

**Project Overview**

Figure 1.3 Study area. The Wind River Indian Reservation is bisected by the Wind River, which runs from west to east, and bends northward when it reaches Riverton. Green shades represent increased and varied vegetation with altitude.

Spatially, this research investigates a 170 km length of the Wind River, which drains the Wind River and Owl Creek mountains, and runs from west to east through the Wind River Basin (Figure 1.3). It focuses on the region between Dinwoody Creek and the Wind River Canyon, and the width of the area encompassed between its Pleistocene terraces (Figure 1.4). This "settlement
corridor” was selected because of its 1) cultural complexity 2) historical relationship to larger economic and political geographies 3) varied settlement patterns and land ownership 4) human hydrologic alteration.

Figure 1.4 Settlement corridor. This study’s “settlement corridor” appears in blue, spanning 170 km and the width of the Wind River’s Pleistocene terraces.

Temporally, this research addresses a century of change beginning in 1905, a year in which a combination of outside influence and local agency reconfigured regional geographies: the Second McLaughlin land cession had opened reservation lands to homesteading (Wilson 1973, 210-229; Stamm 1999, 243-245), the Chicago and Northwestern Railroad expanded into newly ceded lands (Wilson 1973, 225-226), lands were surveyed for the development of substantial irrigation projects (Wilson 1973, 231-242; Stamm 1999, 243-244), and Indian water rights were soon established by the Supreme Court in *Winters v. United States* (Getches 1993, 7-12; Pevar 2002, 239-240). The study concludes in 2010.
Structured thematically, this dissertation discusses the Wind River riparian “settlement corridor” and its human-ecological relationships through three central themes: settlement geography, place identity, and vegetation change. Following the introduction, each of three chapters addresses one of these themes. The final chapter focuses on interactions between the three themes, and the manifestations of environmental change in an often overlooked portion of the GYE.

This dissertation contributes to two bodies of research. First, it builds on the work of Mark Fiege, Nancy Langston, Cole Harris, Kent Ryden and Yi-Fu Tuan to combine subfields of historical geography and investigate landscape change as a complex, ongoing process between a physical landscape, interacting cultures, and individual perceptions. By integrating more objective methods of identifying change (aerial photos and GIS) with intensely personal interpretations of change (place identity and cultural perception), this research seeks to better understand the entangled ecological, cultural, and psychological roots of geographical change. Second, this research complicates the common narrative of landscape change in the GYE. By exploring diverse historical roots of people in the southeastern portion of the ecosystem, it displays how different values and perceptions, laws and settlement patterns, external political and economic drivers and local agency shape a watershed’s past and its future. Cultural diversity and historical complexity may in fact be an integral part of the creation and maintenance of this region of “distinctive ecological significance” (Gude et al. 2006).
Chapter Outline

Chapter 2 focuses on local landscape alterations and larger political and economic geographies as 1) a radically new economic system, powerful political and institutional frameworks, and new ways of valuing land and water shape the Wind River region, 2) enduring pre-European practices and adapting Native American preferences influence regional geographies and 3) complex “hybrid” cultural and ecological landscapes develop and create heterogeneous change. As natural resource-based capitalism takes root in the landscape, this chapter considers its main enterprises (water diversion and agriculture, ranching, timber hacking, the development of commercial centers etc.) and analyzes their relationships with both cultural histories and larger economic exchanges. Likewise, it analyzes key examples of government roles in landscape change over time, focusing on changes in irrigation policy (the Riverton Irrigation Project, Boysen Dam, and Supreme Court rulings). As it discusses the economic and political drivers imposing change, it notes differences in local cultural values of land and water and the ways they influence Euro-American and Indigenous populations to create, adapt to, and resist different economic and political influences between 1905 and 2010.

Chapter 3 analyzes what Ryden (1993, 25-52) calls the “invisible landscape” or complex intermingling of abstract geographical representation, imagination, meanings and memory that bond people and place. In the context of Chapter 2, this chapter shifts from historical manifestations of riparian change to
internal perceptions, chronicling the changes basin residents perceive between 1906 and 2010. It includes perspectives of Eastern Shoshone, Northern Arapaho and Euro-American people by investigating ways in which the landscape is remembered, the stories through which landscape is conveyed, and the cultural values and beliefs that construct relationship with place. Noting that place identity and landscape perception is both cultural and individual, this chapter discusses the variety of different histories created by people inhabiting the same landscape over time as stories both shape and are shaped by their environment.

Chapter 4 explores two themes expressed by interviewees in Chapter 3: riparian change along the Wind River, and changes in development patterns in the settlement corridor. These themes, related to scholarship on other regional rivers, are complicated in the Wind River Basin by unique histories, land ownership patterns, and cultural preferences. This chapter explores the local fingerprints of these particular relationships through ground and aerial comparative photography. The dimensions of riparian forest and development patterns are assessed by comparing 1948/49 aerial photographs and 2006 NAIP imagery. Change is then analyzed by geographical area and land ownership to better understand relationships between histories, settlement geographies, cultural preferences, and environmental change.

This dissertation concludes by interweaving its three central research themes (settlement geography, place identity, and environmental change). In doing so, the final chapter creates a deliberately complex narrative of landscape change that includes physical processes, the relationship between local and
external economic and political processes, and different values and belief systems for water and land. This narrative investigates the historical roots and unique cultural influences of the Wind River riparian corridor, noting that its future may not necessarily follow development trends of the GYE. Finally, this dissertation concludes with a discussion of the Wind River in a larger western context, where a diversity of peoples successfully and unsuccessfully negotiate water management in arid settings.

Research Context

Figure 1.5 The Wind River Indian Reservation. The Wind River is pictured in the context of Indian and non-Indian lands; reservation lands are depicted in red.

The Wind River flows through the middle of the Wind River Indian Reservation (Figure 1.5) beginning its flow on the eastern side of Togwotee Pass, a low point in the Continental Divide that separates the Wind River and
Snake River drainages, the Missouri and Columbia watersheds, and the Atlantic and Pacific oceans. Snotel data records 40 inches (102 cm) of average annual precipitation on Togwotee Pass (2920m, 9580 ft), which dramatically drops to just over nine inches (23 cm) 120 km downstream near the Wind River Diversion Dam (1701m, 5580 ft) (Natural Resources Conservation Service 2010; Western Regional Climate Center 2010). As a major water conduit, the Wind River supports a flourishing riparian zone which hosts farming and ranching lifestyles, an array of wildlife, and the population and cultures of both dispersed and congregated communities.

Wind River ecology is typical of Rocky Mountain headwaters streams of this latitude. Its vegetation follows well established gradients that exhibit vegetation change with both change in elevation and with distance from water. While elevation may be the largest determinant of vegetation pattern, floodplain width, flow regimes, grazing patterns, ice scour, substrate, and stream morphology also influence species distributions (Knight 1994; Wohl 2001). Thus, Wind River vegetation displays a variable mosaic, characteristic of GYE rivers, changing with environmental variability.

In addition to serving a variety of ecological functions, riparian plants play essential cultural roles. The Wind River riparian zone is an integrated ecological and cultural landscape with deep, continuous roots for Eastern Shoshone people and (arguably) the Northern Arapaho. These two cultures, in addition to Euro-American newcomers attracted to irrigable lands along the Wind River, form the three central historical roots of the present and complex cultural geography.
Eastern Shoshone people are thought to have entered the Great Plains from the Great Basin circa 1350, when the Little Ice Age dried the Great Basin and brought increased precipitation and game to the plains (Stamm 1999, 4) though at least some Eastern Shoshones believe they inhabited the Wind River area earlier (Teran personal communication 2007). Regardless, Chief Washakie, who was on good terms with the U.S. government, selected the Wind River Basin as the Eastern Shoshone reservation in the Ft. Bridger treaty of July 3, 1868 (Wilson 1973, 165; Stamm 1999, 47-51). The Northern Arapaho arrived a decade later, in 1878, when the tribe was temporarily deposited in the reservation’s southeast corner by military escort. The Eastern Shoshone protested Arapaho settlement, and the Northern Arapaho themselves lobbied for their own reservation until 1885; however, joint ownership of the reservation was recognized during treaty negotiations in 1891 (Stamm 1999, 242) and in 1937 the Eastern Shoshone were finally compensated for half the value of the reservation (Wilson 1973, 243).

A combination of factors allowed Euro-American settlement within the 1868 reservation boundaries: 1) non-Native agency employees were allowed to live, farm, and raise livestock on reservation lands from the Wind River agency’s inception, and many trespassers were overlooked by early government-appointed agents (Stamm 1999, 63-74); 2) allotted reservation lands were later leased and sold, allowing non-Indians to establish residences (Wilson 1973, 241-242, 252-271); 3) a series of land cessions and returns opened and closed land to homesteading, establishing pockets of non-Native land ownership (Wilson
1973, 238-251); 4) promoters of the Riverton Irrigation Project deliberately developed and populated ceded reservation lands (Wilson 1973, 231-242; Stamm 1999, 243); and 5) irrigation and transportation infrastructure linked farms and ranches to outside economies, thus providing reasonable livelihoods for settlers (Wilson 1973, 224-225).

These early cultural geographies have shaped Wind River riparian areas for over a century. As Paul Wilson (1973, 92) explains, in his dissertation on reservation ranching and farming, Eastern Shoshone and Northern Arapaho people still live in separate parts of the reservation where “…the character of their respective areas is different; their land use is different,” and the differences are explained by “the people themselves—their perception of the land, their cultural history.” Wilson goes on to compare Indian and Anglo settlement patterns. “Indeed,” he notes, “more white people live within the boundaries of the reservation today than Indians. These people have established yet another relationship to their land; their homes, communities, and land use patterns are dissimilar to those of either the Arapahoe or the Shoshone.”

The Wind River plays a fundamental role in these early cultural geographies. Early Shoshone and Arapaho communities settled along its banks on the western and southeastern parts of the reservation, respectively. Anglo and mixed communities are interspersed between. The Wind River defined the southern boundary of ceded lands in the Second McLaughlin Agreement of 1904, and lands irrigable with Wind River water were the only lands not returned to tribal ownership in the Shoshone Judgment Act of 1939 (Wilson 1973, 215-216).
The only sizable town in the region, Riverton, was surveyed and platted in the big bend of the Wind River in 1904, constructed to support the Riverton Irrigation Project, again irrigated with Wind River water (Wilson 1973, 231). Wind River water, more than any other resource, shaped human geographies of the 20th century Wind River Basin.

The Wind River riparian zone is now one of intermingling histories and perceptions: individually owned farms of homesteaders’ descendants are interspersed with New West conservationists, tribal allotment owners, shared tribal lands, and even the city of Riverton with its several thousand people. Vegetation patterns are part of the cultural mosaic. Wind River flora consists of cultivated and wild species, introduced and native weeds and feed. The vegetative landscape is shaped by both longstanding and relatively new environmental-human relationships, and in turn shapes them.

Water moves through the Wind River watershed in limited supply. It does not meet all needs. For this reason, heated disputes, with clear ecological consequences, have thrived for decades along the banks of the Wind River with two definitive peaks: 1) in 1989 the U.S. Supreme Court granted substantial water rights to the Wind River tribes preceding the rights of other state users (Roncalio 1993, 209-214; Mergen and Liu 1997); 2) in 1992 the Wyoming Supreme Court limited use of tribal water rights to “beneficial” uses that did not include instream flow. The tribes argued that maintaining minimum flows in the Wind River took precedence over water diversion serving ceded tribal lands, but the court sided with the state. As it now stands, the Wind River tribes jointly hold
a water right of 479,427 acre-feet (Mergen and Liu 1997) which they can only use if diverted from the Wind River (Martinis 1993).

These decisions, resulting from complex settlement patterns and conflicting perceptions of justice, plainly impact Wind River ecological processes, where water levels fluctuate dramatically with irrigation withdrawals (Bergstedt and Bergersen 1997). Cultural differences are emphasized in litigations and in water policy. The Tribal Water Code, for example, recognizes the interconnectedness of all natural resources, and encourages water use for cultural, spiritual, and economic means. In contrast, the State of Wyoming emphasizes economic gain first in its state water policy, through agricultural, ranching, industrial and commercial use (Flanagan and Laituri 2004). While water disputes split along largely cultural lines, and the tribes and State vie for power, vegetation moves across boundaries. It responds to, and complicates, the well-worn divides.

This dissertation tries to unravel settlement, perception, and the history of these complex human-environmental relationships by observing vegetation, and people's relationships with vegetation, along the Wind River. While this watershed may be ecologically similar to others in the region, its settlement histories, government policies, economic links, court rulings, and cultural values continue to be unique.
Settlement Geography

Elaborate social and political geographies shaped riparian areas prior to European settlement when (as Richard White 1995, 21 and others emphasize) “space was not empty or free.” Resource availability, cultural and familial relationships, and seasonal migration governed highly structured geographies (White 1995, 15-24; Harris 1997, 108). Sizable archaeological sites are located along Wind River tributaries, and oral histories recount them (personal communication with Collins 2005, Teran 2007 and Catron 2007). When interviewing Wind River elders about cultural values of water, Flanagan and Laituri (2004) found that “medicine flowed along the rivers” (meaning medicinal plants grew near streams) and at least one territorial dispute took place just north of the Wind River on Crowheart Butte (Trenholm and Carley 1964; Urbanek 1974). In an arid landscape, riparian areas play a particularly vital role.

Several historians and geographers describe heterogeneous patterns of change in riparian areas following European settlement. Nancy Langston (2003) chronicles ecological changes in the Malheur Lake Basin as Paiute hunters and gatherers are replaced by white ranchers, followed by irrigation developers, speculators, engineers and wildlife biologists. Each cultural group develops its own relationship with its environment and, as Langston emphasizes (10), “the effects of different groups on the riparian landscapes were profoundly different.” Blake Gumprech’ts *The Los Angeles River* (1999), White’s *The Organic Machine*
(1995), Matthew Evenden’s (2006) article on irrigation, environment and social change in the Canadian Pacific Railway’s Eastern Section, and Cole Harris’s (1997) essay on the Fraser Canyon in *The Resettlement of British Columbia* chronicle similar cultural changes and their profoundly different effects on riparian areas. Whether the resulting mosaic is of a riparian area “subdivided into separate spaces” each governed by destructive single-mindedness (White 1995, 112-113), or more temporal, shaped by the same inhabitants as they redefine their relationships with riparian areas over time (Langston 2003, 4-11), it is important to consider the reasons behind the various patterns. Cultural preferences are not simply that; social and political undercurrents drive relationships that shape riparian areas heterogeneously.

The introduction of capitalism to the West marked the landscape with its characteristic booms and busts, rapid and sometimes thoughtless development of transportation corridors, and favoring of certain people and places at the expense of others. William Cronon writes that “few economic institutions more powerfully affect human communities and natural ecosystems in the modern capitalist world” than commodity markets (1991, xv). Richard White (1995) and Cole Harris (1997) examine the social and ecological consequences of rivers as they become key links to global systems of commerce. The Columbia River, in White’s words, becomes an “organic machine” created by a combination of labor, natural processes, and energy. The river is mechanized, but still linked to natural systems as technologies increase efficiency and the river supplies food, energy, and water to expanding markets. Cole Harris cites the gold rush of 1858 as the
single event that shifted cultural geographies from dominantly native to dominantly immigrant in British Columbia’s Fraser River Canyon. Following this shift, the river basin is further transformed as transportation networks begin to build and farming takes root, at the expense of complex indigenous geographies and systems of exchange.

Resource-based capitalism is only part of what drives Harris’s sense of geographical change. The effects of capitalism are coupled with tactics of social control as they reshape indigenous geographies. Heavily influenced by Foucault, Harris describes the introduction of unfamiliar systems of power into the Fraser River Canyon, controlling indigenous populations, first through outright violence, and later by more subtle systems of land ownership and law. Nlha7kápmx reserves, when established, were small, and water rights questionable. Indian Commission of Native Affairs officials “believed in individual liberty while participating in a colonial process that denied it. They believed in economic development, the market, and Native agriculture, while examining a reserve system that provided insufficient arable land, water, and market access for commercial farming” (132). After the mid-1880s, immigrant British Columbians were oblivious to processes of colonialism and their own role of their society on the peoples they had displaced. The landscape was peopled by “a severely disrupted indigenous population and a largely immigrant population detached from the circumstances of former lives” (252). For Harris, colonialism is an ongoing process of “an invasive society… denying the destruction it wrought” (274). Systems of commerce, property ownership, and shrinking indigenous
geographies are manifestations of power relationships in which the powerful easily forget, and the powerless continue to struggle with ongoing problems of a colonial regime.

Donald Worster, in *Rivers of Empire* (1985), suggests that large scale water manipulation itself encourages centralization of power. It is not merely a manifestation. A regulation such as the Doctrine of Prior Appropriation, he notes, could only seem natural and reasonable to “a group of people who were intent on conquering, expanding, accumulating, and getting ahead” (92). Matthew Evenden (2006) importantly reminds us that large irrigation enterprises often suffered from “entrepreneurial over-ambition,” faced enormous economic challenges, and often folded. Irrigation and power were not a combination in which success was guaranteed.

To both Langston and Worster, more democratic processes are the key to equitable use of western water and ecological integrity. Langston frames adaptive management (responding to changing understandings of dynamic ecosystems) within the context of American pragmatism to promote resolution of environmental conflict in more productive ways. By examining the works of Charles Pierce, William James, and John Dewey, she suggests that a democratic process “should both empower multiple voices and devise a method for negotiating the conflict those multiple voices soon lead to” (2003, 161). Likewise, Worster (1985, 332) writes:

> Immense centralized institutions, with complicated hierarchies, tend to impose their outlook and their demands on nature, as they do on the individual and the small human community, and
they do so with great destructiveness. . . . A social condition of
diffused power is more likely to be ecologically sensitive and
preserving. . . . In short, the promotion of a democracy, defined
as the dispersal of power into as many hands as possible, is a
direct and necessary, though perhaps not sufficient, means to
achieve ecological stability.

Langston (2003, 58) believes that the legal process plays an important
role in forcing changes in the balance of power. Litigation forces “people,
institutions, and states to incorporate new ideas into their worldviews.”
Geographer David Harvey, and others describe instances in which power
structures are embedded in the legal process, skewing court decisions in favor of
more experienced, more powerful litigants. Both views are important to consider
with respect to the Big Horn lawsuits which, ironically, adjudicate Wind River
water, but are named after the Bighorn River, the name given to the Wind River
when it leaves the reservation. These heated cases, with ecological
consequences, center on Indian water rights and set precedents still questioned
in the legal literature (Martinis 1993; The Regents of the University of California
1994; Mergen and Liu 1997; Shepherd 2002).

Heterogeneous patterns of land ownership and water dispersal are
baffling, at first and even second glance in Wind River riparian areas, where the
above discussion on capitalism and power dynamics offers insight, as do careful
historical reconstructions of when, why, and how particular changes happened.
Relics of old dams, tie drives, and railroad bridges are visible alongside newer,
more advanced technologies and efficient links to larger economies. Langston
(2003), Gumprecht (1999), and Wohl (2005) describe similar processes of
change, driven by resource-based capitalism as it continues to transform the river over time. Glaring discrepancies in revenues and water distribution further divide Native and non-Native land owners along the Wind River. Teno Roncalio, the court appointed special master to the 1992 Wyoming Supreme Court case writes (1993, 210), “The Riverton Reclamation Project, largely non-Indian, to date has received $70 million of federal funding during the same period that $4.4 million was spent on Indian systems.” Worster and particularly Harris and his “geographies of exclusion” (1997, 136) give light to the subtle, indirect ways that centralized power structures distribute and support wealth. Finally, Langston and Worster link relationships between democratic processes, or lack thereof, and a landscape’s ecological integrity.

Place Identity

The link between place and identity has been well explored among geographers, though both terms are often vague and broadly defined (Zelinsky 1973, 36-64; Meinig 1976). In this research “place” refers to “the process by which people give meaning to location, particularly to how they create social geographies that are rooted in community” (Wyckoff 1999, 6) and place identity is the way we know and recognize ourselves, and are known and recognized by others, with respect to place. As Ryden notes (1993, 40), “This sense of identity may be one of the strongest of the feelings with which we regard places… this feeling of identity helps give order, structure, and value to the geographical world.”
Meinig (1976, 47) suggests “...any landscape is composed not only of what lies before our eyes but what lies within our heads.” Similarly, Fiege (1999, 171) writes, “Idaho’s irrigated landscape was a world made of many things: water, earth, and concrete, plants and animals, laws, policies, and social institutions, sweat, and economic relationships. But it was also a world that was inseparable from the activity of the mind, a world made from the imagination.”

Irrigation is built in the mind long before it is constructed on the land or as Tyrrell (1999, 103) succinctly puts it, “For the historian of popular environmental thought, irrigation is not about drains, pumps, pipes and dams, but about dreams.”

White (1995) goes on to note the human tendency to be myopic. When reflecting on water, humans have a somewhat narcissistic bent, which is particularly problematic with a resource that is both fluid and shared. White (110) writes:

Fishermen see habitat. Irrigators see water. Power managers, utility operators, and those who run aluminum factories see reservoirs necessary to turn turbines. Barge owners see channels with certain depths of water. Environmentalists see brief stretches of free-flowing water. All stake a social claim to their part of the machine. None of them are concerned with the river as a whole.

Likewise, Nancy Langston (2003, 162) explains that, according to pragmatists, “Groups usually naturalize their own values, making them seem inevitable, God-given, and beyond the reach of discussion or change. People often find themselves unable to change such naturalized perspectives without abandoning what they see as part of themselves.”
Place identity is not only one of the strongest bonds between people and place, it can play a central role in cultural conflict. Legal battles, water rights disputes, arguments about water use, fisheries, and dams stem from value systems, notions of justice, and senses of belonging deeply entrenched in a place on the landscape and in the mind because “beyond the visible reality lies a moral reality which they themselves have come to embody” (Basso 1996, 146). White (1995, 45) concludes, “Crises in the Columbia fishery have never been just questions of salmon; they have been questions of proper ways of life.”

Vegetation Change and Human-Environmental Relationships

An extensive and growing body of work discusses vegetation change along Rocky Mountain and Great Plains rivers. Themes include: downstream vegetation response to damming and diversion (Rood and Mahoney 1990; Graf 1999; Katz, Friedman, and Beatty 2005); changes in the establishment and regeneration of cottonwood seedlings and saplings (Cordes, Hughes, and Getty 1997; Rood, Kalischuk, and Mahoney 1998; Auble and Scott 1998; Kalischuk, Rood, and Mahoney 2001); human induced alluvial water table declines and their impact on vegetation (Scott, Shafroth, and Auble 1999; Johnson et al. 1995; Williams and Cooper 2005); correlation of vegetation establishment to altered flow patterns (Scott, Friedman, and Auble 1996; Auble and Scott 1998); the influences of natural and artificial disturbance on riparian vegetation (Auble and Scott 1998; Samuelson and Rood 2004 on grazing; Nilsson et al. 2005 on log floatways; Scott, Friedman, and Auble 1996 on ice scour); the proliferation of
invasive species (Pearce and Smith 2001; Friedman et al. 2005) and others. While these themes all relate to Wind River riparian areas to some degree, my work does not attempt to uncover specific ecological patterns and hydrological relationships as does Merigliano and Polzin (2003) and Merigliano and Williamson (2007) on the Yellowstone and Snake Rivers, respectively. Rather, it assumes these well observed ecological patterns relate to known changes along the Wind River, and focuses on broader relationships between shifting settlement patterns, value systems, and environmental effects. Its methods are used to observe broad vegetation trends in order to better understand the human-environmental relationships related to change. They include the use of aerial photographs, ArcGIS, and ground repeat photography, see (Freeman, Stanley, and Turner 2003; Merigliano and Polzin 2003; Stromberg et al. 2010; Merigliano and Williamson 2007; Platt and Schoennagel 2009).

Geographers and environmental historians have long emphasized the link between nature and humans, and the unfortunate consequences of separating them on the landscape and in our minds (Marsh 1864, 1-5; Cronon 1991, 364-371; Jackson and Horowitz 1997, 339-343; White 1995, 30-58). This research follows their philosophical vein; the GYE, even where people are excluded, is a cultural landscape in its entirety. It is, as Richard White (1995, 112) describes of the Columbia River “at once a natural space and a social space” where the history of the ecosystem and human history merge.

Fluvial geomorphologist Ellen Wohl, in Virtual Rivers (2001), describes the way Euro-Americans have shaped and continue to shape rivers and their riparian
areas. In her examination of 150 years of environmental change, Wohl cites specific historical events and their morphological and ecological effects. Though forgotten by many, early tie drives, irrigation and grazing have created lasting ecological consequences in Colorado Front Range headwater streams, even in instances where human activity has disappeared and streams appear to be pristine.

Ian Tyrrell, as an environmental historian, delves more deeply into cultural influences of ecological change as he specifically addresses vegetation and irrigation development in *True Gardens of the Gods: Californian-Australian Environmental Reform, 1860-1930* (1999). He stresses that vegetative landscapes are cultural landscapes, and, as such, symbols of the aspirations of social groups and classes located in historic time. A vegetative mosaic results from changing cultural philosophies and subsequent technologies. In some instances (e.g. tamarisk) Thomas Jefferson’s proclamation that the “greatest service which can be rendered any country is to add an [sic] useful plant to its culture” (1999, 19) may have gone dreadfully awry. The Garden myth of greening the desert may have fallen short of ideals. But, in each case, riparian inhabitants strove toward the vision of a better world. Actions followed beliefs; crop selection, species introductions, and even irrigation, were intended to improve nature. The vegetative mosaic serves moral purposes, even if (as in portions of the GYE) the moral purpose requires the land to be left alone.

Fiege (1999) and Evenden (2006) further complicate this dialogue, paying particular attention to reciprocity within the human-environment relationship. The
natural world does not lie inert alongside human change. Rather, it responds dynamically and unpredictably. Weeds take root and animals find new niches, as farmers wonder what happened and defend their domain. As both human and natural systems adapt and respond, new relationships develop and form a social and ecological whole. Fiege (1999, 9) writes, “An older, perhaps more natural environment was eliminated, but in its place stands a new, hybrid landscape that should be understood on its own terms.” Or, as White writes (1995, 109), nature is “at once our creation and retains a life of its own beyond our control.”

Thus, the Wind River is shaped by, and shapes its inhabitants. Its riparian area is partially within, and partially beyond, human control. Riparian vegetation responds to watershed processes and social patterns. As importantly, it is also at least a partial product of different cultural groups’ changing philosophies, representations of a vegetation ideal, and the hybridization of people and vegetation as they adapt and respond to change, becoming their own unique social and ecological whole.

**Conclusion**

This dissertation suggests that internal landscapes and external landscapes are closely linked and relevant to ecosystem change; for example, shifts in the “moral imagination” (Basso, 1996) may play as important a role as alterations of flow regime in riparian change. The complexity of human-environmental interactions in landscape change is baffling, but we do them a disservice when we oversimplify. We risk managing ecosystems homogeneously
and may undermine the cultural diversity critical to ecosystem diversity and vice versa. Resilience of the ecosystem as a whole may relate to the heterogeneity of its cultural-ecological relationships.
CHAPTER 2

THE “CRAZY QUILT”: SETTLEMENT AND ENVIRONMENT IN THE WIND RIVER BASIN 1868-2010

Figure 2.1 The Wind River descends from its headwaters on Togwotee Pass through a region of arid badlands. Photo courtesy of the Riverton Museum, date unknown.

Introduction

The Wind River Basin, at first appearance, is a rugged and barren expanse (Figure 2.1) cupped by dramatic mountains to the north and to the west. Irregular ribbons of vegetation line the few waterways that drain the high country. The landscape appears mostly empty, perhaps a portion of the West that hasn’t much changed. After all, it is part of the Greater Yellowstone Ecosystem, spans an area about the size of Yellowstone National Park, and much of it is reservation land. Its appearance is deceiving; a closer look reveals a tangle of land ownership patterns, convoluted histories, and a landscape that has been transformed dramatically—both culturally and environmentally—over the past
century and a half. When John Collier addressed the Plains Congress in 1934, he referred to land ownership patterns on reservations as a “crazy quilt” (Deloria 2002a, 33). This kind of textile, with its colorful geometric shapes all stitched to a backdrop of land, perhaps best conveys this place, which is much more complex than it appears.

Mark Fiege (2005, 46) writes that oversimplifying human geographies fails to convey “the historical and geographical texture of such places.” He writes:

Many forms of private land have existed in the West, with many different owners, occupants, tenures, rules and regulations. The region also has encompassed a range of public lands and spaces, with a correspondingly diverse array of uses, customs and laws. These multifarious private and public lands have not existed apart, but have been connected to and have overlapped one another… These spaces and their relationships, furthermore, were never stable. Economic and environmental changes shaped and reshaped them, as did human relationships that could be formal as well as informal, cooperative as well as contentious. These, then, were the kinds of spatial patterns that constituted rural western landscapes… (46-47).

The Wind River Basin is one such rural western landscape, shaped and reshaped environmentally, economically and culturally, pressured from outside interests and transformed internally by local concerns. This chapter unravels the development of these “multifarious” lands and their cultural and ecological relationships over the last century and a half. Its intent is to exemplify the complexity of rural western landscapes and the way diverse human-environmental relationships defy generalizations and transform geographic space into textured place.
The Drawing of Lines and the Marking of Borders: 1868-1905

This dissertation focuses on a century of change (1906-2010) but nineteenth-century events often set cultural and political contexts for later years.

Boundaries and Legal Control

The Second Treaty of Ft. Bridger (1868) established the Shoshone Reservation as a 3,054,182-acre parcel of land in what is now north-central Wyoming. This seems sizable until one compares it to the 44,672,000 acres originally set aside by the First Treaty of Fort Bridger (1863). The land loss was to continue. In 1872, the Brunot Agreement arranged for 710,642 acres to be sold on the southern end of the reservation for $25,000 and a cattle herd in exchange for the Sweetwater mining districts, agricultural and ranching lands (Stone 1944, 1; Stamm 1999, 96). In 1896 the First McLaughlin Agreement disposed of another 55,040 acres of northern reservation lands, what is now the Thermopolis hot springs, for $60,000 (Figure 2.2).

At that point the Northern Arapaho Tribe, which was promised but never given its own piece of land, had been accompanied by military escort to the southeast corner of the reservation. While this had been accepted by the Eastern Shoshone Tribe as a temporary arrangement, by 1896 it was clearly permanent, and the $60,000 First McLaughlin Agreement was adjudicated as a single negotiation between the two tribes, despite the protest of Chief Washakie and the enduring resentment of the Shoshones (U.S. Congress 1931; Stamm 1999, 243).
The most detrimental land cession, and the land cession most relevant to the environmental and settlement history of the Wind River Basin, concerned lands alienated from the reservation in the Second McLaughlin Agreement of 1904 in which 1,480,000 acres of tribal land north of the Wind River were ceded to the federal government. Lands would be sold under the homestead, town-site, coal, and mineral land laws, at a price of $1.50 an acre for the first two years, $1.25 for the following three years, and after five years, to the highest bidder (33 Stat. 1016 1905). By 1905, the size of the diminished reservation covered just 808,500 acres, shared by two tribes (the Eastern Shoshone and Northern Arapaho) with a less than friendly history between them.

Scholars offer several reasons for tribal land loss resulting from the Brunot (1872) and McLaughlin Agreements (1896 and 1904). Stamm, for example, notes that white townspeople and homesteaders, included within reservation
boundaries when the 1868 reservation was established, created immediate tensions between cultural groups and led to the Brunot cession (1999, 51). Starvation certainly played a role in the tribe’s willingness to give up land (51; Wilson 1973, 212). But even if these cessions occurred as a result of local unrest, they were tied into larger trends. These three land agreements supported the development of new economic geographies built by Euro-American settlers and backed by the federal government. They represented an expanding era of natural resource based capitalism, which transformed the region by exploiting resources in order to produce profit. Capitalism would fundamentally change Western human-environmental relationships, and leave a characteristic fingerprint on the lands it touched. The growth of this economy, and these markets, required local resources, and these resources abounded on reservation lands.

The Second McLaughlin cession differed from other land cessions, certainly in size, but also in design. While the Brunot and First McLaughlin cessions were peripheral to core reservation communities, the Second McLaughlin Agreement included lands in the heart of the Wind River Indian Reservation where Indian water was as valuable as Indian land.

Population and Settlement Patterns

The 1904 McLaughlin land cession took place at the tail end of a pivotal time. Buffalo had been eradicated from the plains in 1885, severely impacting the regional economy. Hunger, malnutrition and disease were rampant on the
reservation and poor administration, sub-standard rations and crop failure made
matters worse (Wilson 1973, 212); Stamm cites a 10.8 percent decline in
population between 1885 and 1900, and a 32 percent decline in the population of
Shoshones and 14.6 percent of Northern Arapaho between 1878 and 1900. In
1900, only 841 Shoshones and 801 Arapahos remained (Stamm 1999, 239). In
1902, population began to again increase (Wilson 1973, 210) and by 1907, when
the first installment from the land cession was paid, the situation was far less
severe. Wage income was already earned from hay, the freight business, hauling
wood, and a growing agricultural economy (214). Wilson writes, “One can only
wonder, under the circumstances, whether the 1904 agreement was really
necessary” particularly since most of the land never sold, and only a fraction of
the anticipated proceeds were realized (215).

Between 1868 and 1905, settlement was closely related to tribal affiliation.
In the years prior to Arapaho occupancy, Shoshone settlement took place
gradually. Few tribal members remained on the reservation year round in the
early years of the reservation. Settlement differed very little from the pre-
reservation era when bands and family groups followed seasonal cycles (Stamm
1999, 79, 96). Eastern Shoshones typically gathered in the Wind River Basin in
late winter and again in the fall to prepare for buffalo hunts in the Big Horn Basin.
During the summer and in winter, the tribe dispersed, traded, and either hunted
and gathered or survived on stored food (53). Because of declining buffalo herds,
clear government intentions, and pressures from Euro-American settlers as well
as warring tribes, most Shoshones settled year round on the reservation by 1885
(193). Two centers of Shoshone settlement developed: Ft. Washakie (originally Camp Brown) was located at the junction of the North and South forks of the Little Wind River, and the agency and Episcopal Mission were located on Trout Creek, (Stamm 1999, 196; Fowler 1982, 82-83). Shoshone camps lined both forks of the Little Wind Rivers and Trout Creek, and were scattered as far as the Big Wind River and the upper reaches of Sage Creek (Figure 2.3). All Shoshones settlements were located on the western portion of the reservation, at the base of the Wind River Mountains.

Figure 2.3 Arapaho and Shoshone settlement along the Little and Big Wind Rivers and their tributaries,1886-1889. Modified from Fowler, 1982.
Conversely, Arapaho settlements clustered on the eastern portion of the reservation. They dispersed from two original encampments to smaller camps spread along the Little Wind River eastward from the Hot Springs downstream to the junction of the Little Wind and Wind Rivers. Camps were organized in family units that shared provisions and were structured around elders and council chiefs. The Arapaho Sub-Agency was established in 1892; St. Stephen’s Catholic Mission in 1884; and St. Michael’s Episcopal Mission in 1913, all of which became Arapaho hubs (Figure 2.4) (Fowler 1982, 68, 94, 137).

Figure 2.4 Map of Shoshone Reservation communities, late 1800s to early 1900s. Shoshone communities depicted in red, Arapaho communities in black.
While tribal and family affiliations were the earliest and strongest influences of settlement patterns, the federal government applied its own vision of reservation settlement through allotment policy. It began to use its considerable influence to reshape reservations from communally owned lands to individually owned parcels of land.

**Reservation Land Allotment:** Beginning with the 1868 reservation treaty, federal allotment policy began to fragment reservation lands. Between 1868 and 1905 the tribes would witness the conversion of prime agricultural lands in the Wind River Basin from tribal territory to commodity, a pattern common across the West.

Allotment policy was brewing for many years before the General Allotment Act, or the “Dawes Act” was passed in 1887. Pevar writes that support of allotment was shaped by two forces:

The first was a desire to take additional land from Indians for settlement by whites. The second was a belief shared by many non-Indian social reformers that the best way to help Indians overcome their poverty was by encouraging them to assimilate into white society. Although their motives differed, both groups joined in compelling Congress in 1887 into passing the General Allotment Act… (2002, 8)

The General Allotment Act encouraged an ethic of private property on reservations by dividing tribal lands into small parcels for individuals or families to own. Once lands were distributed, “surplus lands” were opened and sold to settlers. The rhetoric promoted that, “…land would become available for non-Indian settlement, and Indian poverty would be eliminated once Indians emulated
the work habits of their new neighbors” (Pevar 2002, 9). The results were shocking. By the time the Act was repealed in 1934, 150 million acres of land had fallen out of tribal ownership, and less than 50 million acres remained. After a “trust” period of 25 years, the Allotment Act allowed Indians to sell their lands, which many did, and unpaid taxes resulted in land foreclosures and additional non-Native settlement on Native lands. Indian poverty was certainly not eliminated. Furthermore, many Indians did not want to abandon communal societies and communal land ownership; were not interested in farming and ranching on individual tracts of lands or did not have the capital and equipment to successfully farm or ranch; and the irrigation infrastructure for farming, and the massive amounts of labor and capital was not in place even if they did.

Allotment Policy in the Wind River Basin: Unlike many reservations, tribal allotment was written into the Shoshone Reservation’s 1868 treaty. Article VI of the treaty reads, “If any individual belonging to said tribes of Indians…shall desire to commence farming, he shall have the privilege to select…a tract of land…so long as he or they may continue to cultivate it” (15 Stat. 673 1868). The policy was instantly problematic. While every family was entitled to 320 acres of land, and every person over 18 to 80 acres, there was not enough irrigated land to fulfill these promised allotments, and even if there had been 320 acres for everyone, that sum was still too small for a family to support itself on range land allotments in such an arid region. It was not possible to “continue to cultivate it” or to cultivate it at all. In response to land shortages, in 1906, the year after the
Second McLaughlin Agreement was approved by Congress, allotments of heads of families were decreased to only 160 acres, while those over 18 would still receive 80, and minors would receive 40 (Wilson 1973, 253-254, 257-258). The terms of the original Allotment Act replaced those of the reservation treaty.

Several allotment geographies developed that were specific to Wind River. 1) Allotments were a variety of sizes; 320-acre parcels were a result of the 1868-1906 allotment era; and 160- and 40-acre allotments were a result of the 1906 era. In addition, the shortage of irrigated land available resulted in 100-acre “companion allotments.” Twenty of the 100 acres were located in irrigable areas, while the other 80 might be located as far as ten miles away (Wilson 1973, 261). 2) Allotments were given to those with “dubious ties to Wind River peoples”. Both Wilson and Stamm, for example, puzzle over the reason that several Sioux allottees were given Wind River land (Stamm 1999, 245; Wilson 1973, 263), and Stamm exemplifies the ways that allotment favored those who were already integrated in non-Native culture through intermarriage (244-245). 3) “Surplus lands” were never opened for homesteading; unallotted lands on the diminished portion of the reservation remained in tribal control. 4) The 1906 cession complicated the allotment process. Several allotments had already been given to tribal members in lands that were to be ceded.

No definitive legal process guided Indian allotments on the north side of the river. The McLaughlin Agreement stated that Indians within ceded portions of land north of the river could opt to keep or surrender their allotments, yet Wilson writes that these allottees “were encouraged to exchange their allotments for new
ones situated within the diminished reservation” (259). He then gives conflicting information, suggesting “all but a handful complied,” but also “many were reluctant” and stayed. Fowler suggests that several Arapahos protested the cession because they owned lands north of the river (Fowler 1982, 93-94). Regardless, several parcels of land still designated as “allotted lands” exist on the north side of the river and remain in individual tribal ownership.

Figure 2.5 Areas of Shoshone and Arapaho allotment, with an additional area of Sioux allotment. Image based on Wilson, 1973, used with permission of the author.
In sum, 2,492 allotments were issued between 1868 and 1931 (Wilson 1973, 266), many near the Little Wind, Popo Agie, and Big Wind Rivers (Figure 2.5). Along the Wind River, Arapaho allotments tended to be in the “big bend” of the river near what is now Riverton, near the area the Lower Arapahos inhabited when they arrived on the reservation. Shoshone allotments were concentrated on the northwest end of the river. The Wind River tribes fared better than many tribes in the land allotment program. Wilson estimates that 17.2 percent of allotted lands were lost (Wilson 1973, 269). He does note, as is obvious on any land ownership map of the reservation that, “There is a close relationship between non-Indian alienated allotments and irrigated land” (Wilson 1973, 270).

As tribal populations began to recover from less than 1,000 members per tribe, settlement patterns continued to develop on prototypes of this era: first, through cultural and familial networks, secondly, through both issue and loss of allotted lands, and third, through government and church establishments.

**Land and Water Use**

**Irrigating Indian Lands:** Alongside the rapid conversion of tribal territory to private property was the realization that arid land required irrigation to grow anything but desert scrub. The treaty overlooked the simple fact that water would be essential. If any Indian “shall desire to commence farming” on allotted lands, as the 1868 treaty encouraged, the Indian shall need water, which the treaty overlooked. Since lands had already been allotted based on the location of
irrigation that had not yet been developed, rapid irrigation development was critical if the tribes were to be converted to farmers (Wilson 1973, 255).

The earliest irrigation history on the south side of the Wind River is somewhat nebulous and difficult to reconstruct precisely. A number of non-Native families settled in the basin before the establishment of the 1868 reservation and irrigated their lands (Gerharz 1946, 1). These families were instrumental in building irrigation canals, instructing others on irrigation techniques, and providing irrigation infrastructure for tribal members who later settled these lands (Gerharz 1946, 13; Bureau of Indian Affairs 1950). It is also thought that Chief Washakie brought back ideas from Mormons in Utah, and began to irrigate 300 acres of land near the Little Wind River (Gerharz 1946), though Frandrich and Stamm suggest this was more political than genuine; among other things, he was interested in houses, which would be provided if Shoshones farmed (Stamm 1999, 104-105; Fandrich 2007). In the late 1880s farming began to increase in the form of plots of vegetables and hay tended by bands, though little progress on government irrigation was made until the mid 1890s (Fandrich 2007). Fowler (1982) describes the dispersal of Arapaho families “attempting to cooperate with the agent and raise hay” to areas along the river where they were able to construct ditches. She quotes Arapaho Henry Lee Tyler as he describes:

…In farming we cannot get results without water, so these people…tried to make their own ditches. A little further down, another bunch of Indians tried to construct their own ditches as best they knew how. Still further down, another ditch was constructed by the Indians…Each year, more Indians tried to farm and eleven or twelve ditches must have been made by these Indians (75-76).
Early irrigation ditches were hand-dug by both Shoshone and Arapaho people and at least one community ditch was allegedly built in exchange for government rations. Early crops consisted of wheat, oats, hay and Indian corn; alfalfa was introduced in 1884 (Gerharz 1946, 2). Lands east of the St. Michaels Mission and between Fort Washakie and the Little Wind River were irrigated and farmed; the Ray Ditch, a ditch near the Arapahoe Sub-agency; and a ditch near what is now Coolidge Canal were all developed before 1900 under the supervision of government agents (Gerharz 1946, 2; Bureau of Indian Affairs 1950, 13-14). In 1900, the first comprehensive study of Indian irrigation formalized irrigation development, and determined that five irrigation units should be constructed: the Upper Wind River, Little Wind River, Johnstown, Left Hand, and LeClair units (Bureau of Indian Affairs 1950, 13-15) at an estimated cost of $760,000 (Stone 1944, 7). Irrigation planning evolved from this early survey, first called the Shoshone Irrigation Project, and later the Wind River Irrigation Project.

Funds received from land sales in the Second McLaughlin agreement of 1905 were intended to fund a portion of the Wind River Irrigation Project. The government never wrote blank checks. The Second McLaughlin Land cession, approved by Congress in 1905, Article IV states:

It is further agreed that of the moneys derived from the sale of said lands the sum of one hundred and fifty thousand dollars, or so much thereof as may be necessary, shall be expended under the direction of the Secretary of the Interior for the construction and extension of an irrigation system within the diminished reservation for the irrigation of the lands of the said Indians (33 Stat. 1016 1905).
An additional $85,000 was allotted for per capita payments, $50,000 for livestock, $50,000 for a school fund, and funds for surveying and planning water rights for Indian lands as well as a general welfare investment fund were to be arranged (33 Stat. 1016 1905). As Wilson points out, $150,000 was a pittance with respect to irrigation development; it was spent by the end of 1908 when not even one irrigation project was completed (Wilson 1973, 218). When tribal members first received allotments in the irrigation project, they moved to their individual lands for summers and back to the lands along the rivers in the fall; when the canals quit running in fall, they had no water (Bureau of Indian Affairs 1950, Appendix 8). Several government reports support the notion that the purpose of the McLaughlin sale was to fund irrigation development on the reservation, and that the cost of development was “supplied in part from the money received from the sales of land on the ceded portion, made available through the provisions of the Treaty of June 21, 1904” (Gerharz 1946, 1). In truth, much more of this money was provided by a rider to an appropriations bill in 1914 (Wilson 1973, 218) which also required the tribes reimburse the government for construction charges.

Like so much of reclamation planning, the quantity of irrigable lands was overestimated while the capital necessary to develop them was vastly underestimated. As of 1964 only 40,000 acres of reservation lands were irrigated (Bureau of Indian Affairs 1968a, 6; Wilson 1973, 255) as opposed to the original 243,399 acres originally allotted.
Irrigating the Arid Lands: Aridity was an obstacle for anyone settling in most of the West, not just Indians. Rather than changing settlement patterns of the West to accommodate its aridity, as John Wesley Powell suggested, the West was changed to accommodate settlers. Water development was recognized as essential, but expensive. Just as settlers looked to the government to transform Indians, settlers looked to the federal government for irrigation solutions.

Government interest in irrigation, as well as the role tribal lands played, is perhaps best explained through a broader look at irrigating the American West. Its role has been well analyzed by Donald Pisani, Donald Worster and others; particularly with respect to the role of the state, the social effects of power dynamics in water control, and the rural communities that irrigation produced (Evenden 2006). Some of their discussions shed light here.

Worster suggests that “through the 1890s the West milled around, frustrated and uncertain, on a plateau of water development” though he admits it’s “a small but expanding plateau…” (1985, 156). In 1880, 300,000 acres were irrigated in the United States, which burgeoned to more than 4.1 million acres in 1890 and 7.3 million in 1900 (Pisani 2002, 2). The federal government at first played a marginal role in expansion and was reluctant to give states access to public domain lands so they could irrigate large tracts until, in 1894 Congress succumbed to public pressures, and passed the Carey Act (Worster 1985, 157). The Carey Act allowed each desert state access to one million acres held in the public domain. The land would be sold to farmers at a maximum of 160 acres at
$.50 an acre plus the price of waterworks. Monies would go to the federal treasury, and the state would secure a construction company and guarantee them a profit. Worster calls this act “a dismal and discouraging failure” (157) as states were not willing to bear the financial risks and did not apply for lands. Projects in Idaho were an exception as was the Wind River Basin, which will be discussed later in more detail. It is mentioned here as the federal government’s first step into irrigation development on a large scale.

The federal government fully immersed itself in irrigation development shortly thereafter when Theodore Roosevelt signed the Reclamation Act into law on June 1, 1902, initiating what Donald Pisani calls the boldest public works program in the history of the federal government (2002, xvi) and Donald Worster describes as “the most important single piece of legislation in the history of the West” (1985, 130). The Reclamation Act authorized the construction of irrigation projects in sixteen different states and territories of the West. It was to be funded by the sale of public lands, which would then fund irrigation development. Land owners were allowed a maximum of 160 acres and funds offered up front by the government for water development would be paid back under contract (Reclamation Service 1905, 25-28). The Reclamation Service was formed as the government agency that would administer this work.

Thus, three years before the Second McLaughlin Land cession on the Wind River Indian Reservation was ratified, the federal government had launched a massive irrigation enterprise and unlocked a source of capital for its development. The Reclamation Service looked for sizable parcels of irrigable
lands in the West, which was not as easy as the Act made it sound. “At the time the law was under consideration,” the Fourth Annual Report of the Reclamation Service 1904-1905 reads, “it was supposed that it would be applicable mainly to public lands, but results of surveys and examinations of definite projects are beginning to show that the amount of public land which may be reclaimed is not so large as was anticipated and that the lands in private ownership are frequently more important or more valuable than the public lands” (Reclamation Service 1906, 23). The Reclamation Service was not only short of land, it was almost instantly short on money (Pisani 2002, 278).

Irrigation Potential in the Wind River Basin: The government was clearly interested in reservation lands for their irrigation potential for non-Native settlers. Goyne Drummond, on behalf of the Reclamation Service, explored the Wind River Basin and mapped out irrigation opportunities in 1904, between when the Second McLaughlin land cession was made with the tribes, but before it was ratified in Congress. In describing the region, he reports that the Wind River originates in “…the Wind River Range in west-central Wyoming, and carries considerable water, flowing across the Wind River or Shoshone Indian Reservation, where a large amount of irrigable land is located” (Reclamation Service 1905, 117). The majority of the report concerns “the proposed ceded strip” or the area of land north of the Wind River. He later quantifies the amount of irrigable land within that region as 230,000 acres, and though he writes that
lack of accurate maps makes estimates difficult, he believes the estimate is conservative (631-632).

Drummond analyzes the water supply, charts potential canal sites, and suggests four areas for reservoirs of Wind River water (Figure 2.6).

![Figure 2.6 Map of proposed irrigation development, 1905-1906. 8th Biennial Report of the State Engineer, p. 50.]

Some of his original designs came to fruition, and others were forgotten. Two of four proposed reservoirs were eventually constructed Dinwoody Lake and Bull Lake Reservoirs, notable because both were located on what Drummond refers to as “the diminished strip of the Shoshone Indian Reservation”. That is, they
were located on tribal, not to be ceded, land. As if justifying the use of Indian resources, Drummond writes that Dinwoody Lake “can not be used for storing water for Indian lands, nor will its use in any way be of damage to the Indians if utilized for storing water for the proposed ceded strip.” Of Bull Lake, he writes, “A portion of the water of this reservoir might be used for watering about 20,000 acres of the diminished strip, but as the bluffs along the river are very high and broken, the cost would be probably $30 per acre. This reservoir will not in any way damage the Indian lands should it be necessary to use it for storage purposes” (632).

In short, not only did the Reclamation Service mastermind plans for draining Wind River water onto ceded lands before the land cession was ratified, it mapped reservoir sites on not yet “diminished” Indian lands to make its irrigation dreams possible.

Given the eager interests in irrigation development, it is not surprising that the state of Wyoming (a young state, 1890) jumped in, and on August 8th, 1905 requested a more complete survey before these lands were opened to entry. This request was denied. The state then appealed directly to the Commissioner of Indian Affairs, and was granted permission in 1906 to survey ceded lands (Reclamation Service 1917, 12; State Engineer 1905-1906, 30-47). Thus the important, and continuous relationships between the Indian Office (later the Bureau of Indian Affairs), the Reclamation Service (later the Bureau of Reclamation), and the State of Wyoming were sealed; the tribes and their interests, while ever present, were often overlooked.
The Reclamation Service, the Indian Office, and Indian Allotment: The Allotment Act’s role in shaping Indian water receives less attention than its impact on Indian lands, though Donald Pisani (2002, 154-181) explores the relationship between the Reclamation Service and the Indian Office and makes three strong, and relevant points: 1) in the early 1900s, irrigation was seen as a powerful tool for civilizing Indians (157), 2) sales from allotment were a potential pot of money for reclamation shortages (159), and 3) a subsequent and dubious relationship between the Reclamation Office and the Indian Office, sanctioned by the Secretary of the Interior, encouraged the development of irrigation projects on reservation lands and/or irrigation projects using Indian water, with little intention of serving Indian people (161).

Reservations differed in their specific responses to the federal eye for irrigable land and a capitalist economy’s thirst for water, but faced similar pressures. Sauder (2009) describes the way federal allotment and reclamation policy resulted in alienation of 80% of Fort Yuma Indian Reservation lands. A portion of those lands was developed by the Reclamation Service as the Bard unit of the Yuma Reclamation Project. Likewise, Pisani analyzes the ways Yakima and Pima people responded to irrigation and allotment. On the Yakima Reservation in Washington 800,000 acres were opened to white settlement in 1905. The Reclamation Service then received control of irrigation, Indian allotments were reduced in size, new storage reservoirs were paid for out of “excess” Indian land sales, and by 1919 less than 10 percent of irrigated
reservation lands were cultivated by Indians (186-192). The Pimas, in southern Arizona, fought a government proposal to pump their ground water for irrigation, since non-Native users had usurped their surface supply. This expensive operation was to be funded by surplus Indian land sales (180,000 acres), which the Pima refused. A dam was finally constructed for their use in 1930 (Pisani 2002, 193-199).

Pisani stresses that the Reclamation Service and the Indian Office “satisfied Indian water needs only after the demands of white farmers had been met” (200). Moreover, “The Indians paid for this water twice—by the reduction in the size of their allotments, and by the arbitrary use of money from the sale of their ‘surplus’ lands to build dams and canals” (201).

In this context, the Second McLaughlin land cession was not all that unusual. The Wind River Tribes ceded the northern part of the reservation, Indian funds were used to survey and develop irrigation on ceded lands, reservoirs for this irrigation were constructed on diminished tribal lands, and vastly less money was used to develop irrigation on diminished lands.

**A Dynamic Environment**

Prior to 1905, aside from small hand-dug ditches, there was little actual evidence of ambitious irrigation schemes in the landscape itself (Figure 2.7). Early photographs and records of the Wind River illustrate an abundance of cottonwoods, and hydrographs display the spikes of enormous spring flows.
In 1868, W.F. Raynolds wrote of the river near what is now Riverton:

Our route lay up the valley of the Wind River, keeping upon the south side of the stream, and for three or four miles we passed through fine grass. The valley is a mile or more in width, and the immediate banks of the stream for 300 or 400 yards are covered with a thick growth of cottonwood (83).

Of the uplands he wrote:

The soil...is very barren, the surface being parched and dry, and the progress of our train raises clouds of the most disagreeable dust... In its general appearance the plain is not unlike the sand beach of New Jersey, save that it lacks the freshness and greenness of verdure. The vegetation is very poor, and we were greatly troubled to find a spot for a camp that would afford sufficient pasturage for our animals. On the location ultimately chosen the old grass (there being little or no new visible) was as hard and dry as in midsummer (83-84).
As Raynolds found, between the edge of the cottonwood groves and the bluffs, “…the valley contains little besides sage, which is the largest yet seen, many of the bushes being seven feet high, and four or five inches in diameter at the ground” (83).

In 1905, the land undoubtedly looked similar. While the landscape appeared little changed, transformations were well underway. First, human-environmental relationships among the tribes were already in transition. The buffalo economy was about to collapse. Seasonal migrations of Shoshone people in the basin, which were still relatively intact in 1868, had all but ceased by 1885. Arapaho people would soon be deposited in an area they would permanently inhabit. When the tribes settled in the Basin year round, they adopted new lifestyles—they dug ditches and diverted water, they introduced new crops and negotiated with the government for cattle—yet they maintained relationships with the environment that they had developed through time. They settled in family camps and practiced cultural traditions, they gathered plants and hunted more locally. Tribes both transformed and maintained their intimate relationship with place even as their numbers began to increase at the turn of the century.

Second, new human-environmental relationships were brought to the Wind River Basin by Euro-Americans, who had a very different relationship with place than the tribes, importing their sustenance in the form of domesticated plants and livestock. Their survival strategy required that the place change, and rerouting water was central to that transformation. Furthermore, Euro-Americans
were not just interested in survival, they were interested in profit. The capitalist economy they brought commodified land and water. While in 1868, and even in 1905 its impact was not yet apparent, the redrawing of reservation borders, a system of establishing ownership of water, the boundaries of land ownership, and reservoir blueprints drafted the transition on paper, if not yet on the land.

The environment would not remain neutral amidst these cultural and physical alterations. As Mark Fiege, in *Irrigated Eden*, observes, settlers often mistook their blueprint for what would take place on the land. They overlooked unintended environmental responses and “had stolen from nature only to find that nature stole back” (1999, 24). The environment is dynamic, not static. As it responds unpredictably, human communities respond, resulting in a “hybrid landscape”, a human-environmental interplay that is “always in a state of change, always undergoing definition and redefinition” (40).

One more layer of complexity exists in the Wind River Basin: its hybrid landscapes are both cultural and ecological. Unique Indian geographies, such as settlement in cultural and family groups, and unique relationships with the environment were unfolding alongside new technologies and a burgeoning capitalist economy. Shifting power dynamics between cultural groups were evidenced in the drawing of new reservation boundaries. New cultural preferences and power relationships were part of human-environmental relationships in the Wind River Basin. The region’s environment and culture would continue to evolve from this complex mixture of new relationships that were established by the end of the 19th Century.
The Second McLaughlin Agreement (1905) freed lands north of the river to develop according to Drummond’s surveys, or so it was thought. Irrigation was to be the root of a new economy in which large-scale irrigation enterprises would support the expansion of capitalist interests. Improving these lands meant bringing wealth, settlement, and economic prosperity to the region.

Different economic changes shaped patterns on the south side of the river. The tribes developed systems of communal as well as individual land ownership. Irrigation did not take the same turn or support Indian economies in the same way. Ranching interests took root, and land leasing provided a source of income on agricultural lands.
The federal government, and the Department of the Interior in particular, strongly influenced conditions on both sides of the river. The Reclamation Service and Indian Service may have been allies, but when they operated separately, their funding, levels of expertise, and the populations with which they worked, differed dramatically and so did their relationships with the environment. The river was a geographic feature that divided cultures and experiences and the fluid boundary played a significant role. The very act of dividing ceded lands from diminished lands *along a waterway* guaranteed ongoing cooperation and conflict between the various groups involved. The river both connected and divided those who inhabited northern and southern sides of the river as well as those upstream from those downstream (Figure 2.8).

**Boundaries and Legal Control**

![Diagram](image)

**Figure 2.9 Shoshone Reservation boundaries, 1906.** The Second McLaughlin Agreement reduced the reservation to lands south of the Wind River. In 1906 the Wind River marked the northern boundary of the reservation.
When the tribes ceded lands north of the river, the Wind River became a dividing line that demarcated cultural boundaries...at least, on paper (Figure 2.9).

The reservation was now drawn with lines:

Beginning in the midchannel of the Big Wind River at a point where said stream crosses the western boundary of the said reservation; thence in a south-easterly direction following the midchannel of the Big Wind River to its conjunction with the Little Wind or Big Popo-Agie River...thence up the midchannel of the said Big Popo-Agie River in a southwesterly direction to the mouth of the North Fork of the said Big Popo-Agie River; thence up the midchannel of said North Fork of the Big Popo-Agie River to its intersection with the southern boundary of the said reservation...; thence due west along the said southern boundary of the said reservation to the southwest corner of the same; thence north along the western boundary of said reservation to the place of beginning” (33 Stat. 1016 1905)

To clarify, lands north of the river were ceded but still under the jurisdiction of the Indian Office until sold (Indian Service 1912).

The Wind River demarcated significant boundaries; allotment, after all, was an uniquely Indian settlement geography and what would become the Riverton Irrigation Project included only lands north of the river. On the other hand, some allotments already existed on the north side of the river and the Riverton project drew water from reservoirs on the river’s south side. Boundaries were not as straightforward as the lines drawn on maps but they were significant, and played central roles in transforming the region’s economic and cultural geographies.
Population and Settlement Patterns

North of the River: Early irrigation dreams were ambitious north of the river, to say the least (Figure 2.10). Drummond’s estimates of 230,000 irrigable acres between the Big Wind River and the Owl Creek Mountains swelled to 265,000 acres in 1906 when the State of Wyoming opened the project for construction bids (Reclamation Service 1917, 12). The fledgling Riverton Republican newspaper even announced there were potentially 400,000 acres of irrigable land (Riverton Republican 1910).

Soils were advertised as “uniform and of first class quality” by the State engineer (Reclamation Service 1917, 12). The Wyoming Central Irrigation Company produced an advertising brochure to promote land sales that promised no drought, no drowning out, and lands where “Hot winds, destructive storms and cyclones are unknown. The climate is invigorating, healthful, mild, and equable. The air dry and 85 per cent of the days full of bright sunshine” (Wyoming Central Irrigation Company 1907, 2). It offers a map displaying the area’s proximity to Yellowstone National Park (Fig 2.9) though the Tetons are 150 miles away, with limited access. The brochure boasts:

Three things make the climate here the most enjoyable on the continent; eighty-five percent of the days are full of sunshine and blue sky, and every day dry air. Through the gateways of the mountains on the West are admitted the softening and warming Pacific air currents, so the Winters are mild; one may, even in Mid Winter, sit in comfort in the sunshine in any sheltered corner. In Summer shady places are cool, sunstroke is unknown, and every night is full of peaceful sleep…The sparkling, dry, mild air makes life happier and more
satisfactory than it can be under the clouded skies and humid atmosphere of the East and South (15).

Figure 2.10 Advertising map of ceded reservation lands, 1907. A Wyoming Central Irrigation Company brochure entices settlers to ceded lands with a map that extends 150 miles west to the Tetons and Yellowstone National Park. It reads, “Irrigation, Soil, Sunshine and Intelligent Industry Are Wealth Producers.”

Little time was lost between the ratification of the Second McLaughlin Agreement and land opening on ceded lands. The land cession was ratified on March 3, 1905, railroad construction was arranged in fall 1904 and a construction contract with Wyoming Central Irrigation Co. was dated July 11, 1906 (Chatterton 1953, 86-87). Shortly thereafter, a land lottery was scheduled: 10,559 people
applied for land, and 7,240 of those were allowed to draw for 1,600 homesteads. People flooded into the region in anticipation for the opening (Larson 1965, 251-252).

The circumstances of the land opening foreshadowed a new era, and are worth describing in some detail because they are representative of regional trends. Individual capitalistic interests, driven by dreams of profit, clearly trumped logic. Who you knew mattered. Fenimore Chatterton, Secretary of State of Wyoming 1899-1907, visited Washington D.C. in 1905, lobbying for a comprehensive construction plan for the irrigation project; a town, equipped with lights and sewers; and, most importantly, a project backed by “ten Wall Street financiers.” His request was denied with the justification that the Interior Department “would not grant anyone a special privilege to make money” (1953, 85). Chatterton was not deterred. He struggled with the railroads to ensure access to the lands before the opening, and finally arranged a contract with the Chicago and Northwestern Railroad to extend its line from Casper to Lander (86).

The day of opening, August 4th, the railroad had not yet reached the “big bend” of the Wind River, slated to be the central town site for the project. It stopped just short of the reservation boundary in the middle of a dry and dusty expanse that would become the town of Shoshoni (Figure 2.11). One of the prospective settlers described the scene, “When they [prospective settlers] dropped off the cars at Shoshoni and saw great patches of white sand, with the nearest tree ten miles away, they just felt like getting on the cars again and kicking themselves all over. Many of them did not register, but took the next train
home” and another proclaimed “the ride is worth the money, but the land isn’t” (Wind River Mountaineer 1906a; Jewett 1928, 14). This dry and desolate site happened to be a 160 acre tract the general manager of the railroad had obtained (Bureau of Reclamation 1952, 3, Appendix I; Chatterton 1953, 86).

As settlers poured in, the general manager sold off town lots and the town of Shoshoni was born. Though he apparently lost his position at the railroad because of this scheme, it left a lasting effect on the landscape and likely his pocketbook. The railroad resumed construction immediately after the opening and reached the site where the land opening was supposed to take place, rather than Shoshoni, 30 days later. This area, encompassed by the big bend of the Wind River, would become the town of Riverton (Figure 2.11). Chatterton, perhaps because the general manager ruined the plans for his own pocketbook, wrote:

The result was that the trainloads of people coming to Shoshoni for the nefarious lottery system for disposition of the land were daily met by trainloads of people out-bound who yelled at the incoming train ‘Suckers, suckers’ …This bureaucratic land opening farce, together with the refusal to allow canal construction prior to the opening, resulted in very few homesteaders and in delaying the proper development for at least twenty-five years (1953, 86).

Lack of railroad access did not prevent the run for profit on the Riverton town site. Several hundred people found their way twenty miles south of Shoshoni by wagon or on foot. “Tents and wagons by the score were in evidence under the trees along the river,” and their owners planned to stake their claim at midnight on August 14th (Lander Clipper 1906b; Wind River Mountaineer 1906b).
Figure 2.11 The new towns of Shoshoni and Riverton. Shoshoni, where the land opening took place in 1906, was located twenty miles north of the intended town site of Riverton.

Apparently alarmed by the number of six shooters and Winchesters, officials instead conducted an impromptu public meeting to decide how to both proceed and prevent bloodshed. “A women’s right convention could not compare with it when it came down to storminess,” the Wind River Mountaineer reported (Wind River Mountaineer 1906b). The opening was postponed until morning and presumably it was a busy night. Under orders from the Indian Agent at Ft. Washakie, soldiers appeared and declared that the town site opening would not take place for another 60 days (Wind River Mountaineer 1906b; Chatterton 1953, 87); meanwhile, a few squatters “among them several women” sneaked out in the night and staked their claim anyway. Chatterton reports that he kept the “wires to Washington hot” and in ten days the troops withdrew. It didn’t seem to matter. “The soldiers placed a liberal interpretation on their orders and before leaving nearly every one present went on the town site, staked off a quarter block and secured their witnesses” (Wind River Mountaineer 1906b). Inside information
was key. Those who knew where the railroad would run, and where roads were platted would position their claim strategically. One squatter lamented, “When the final opening day did come, lots that I had selected for myself, proved to be in the middle of the street, up on Broadway about opposite the home of the Petersdorffs” (Jewett 1928).

The Wyoming Central Irrigation Company (of which Chatterton was the Vice President and General Manager) won the bid advertised by the State of Wyoming in 1906 (Chatterton 1953) to develop the entire 265,000 acre irrigation plan. Its first project was the Wyoming Canal (later called Wyoming Canal #2), which was constructed to immediately provide water to settlers near Riverton. Settlers were expected to enter into repayment contracts with the company, and the company continued construction based on these revenues. None of this went according to plan. Many settlers refused to enter repayment contracts. Government reports blame speculators: “…too often the homesteaders were not bona fide homesteaders, but, rather, speculators who had neither the money nor the disposition to obligate themselves to develop the land as would be required under a contract with the company” and “…the settler should realize his responsibility in this direction. He should not take up land for the sole purpose of speculation, at the expense of his energetic neighbors and the company which is making the arid land habitable” (Reclamation Service 1917, 14). But popular press had its own slant, “Hundreds of prospective settlers—eastern farmers—have been driven from the state by the rotten contract given to the Wyoming Central Irrigation Company by the state officials” (Carbon County Journal in
Larson 1965) and “…so long as Joy Morton and his crowd are permitted to dictate unreasonable and unlawful terms together with exorbitant prices… no material development can be made or no permanent prosperity attained by the people on the reservation…” (Wind River Mountaineer 1907).

The state and construction company negotiated their contract, and in 1910, Congressional action allowed Carey Act provisions to be applied to ceded lands (Reclamation Service 1917, 15). The Carey Act (1894) allowed states to develop federal lands through private irrigation companies. This made little difference. The company claimed that lands “are not of the quality that had been represented, and many other matters of this kind” (State Engineer 1909-1910, 86) and “we have been terribly fooled” (87) while the state retorted “The land is there. There is enough of it to make the project a great success. There is as much and more of it than I ever estimated. This is no time for running down phantoms and day-dreams” (90). Historian T.J. Larson reflected, in his history of Wyoming, that “Apparently the Wyoming Central Irrigation Company was lucky to get out of the Riverton project when it did, for the item became a perennial object lesson in the formidable difficulties inherent in large-scale reclamation projects of the West” (Larson 1965, 353).

The company completed Wyoming canal #2, but failed to construct anything else at all amidst a tangle of contracts and cancelled contracts, until in 1918 the Reclamation Service stepped in. The Service immediately funded the first extensive surveys of the area, including land classifications, land ownership
delineations, and detailed studies of topography and hydrology, which had never been done (Figure 2.12).

Figure 2.12 Map of the Wind River drainage, 1917. The area shaded in blue outlines the extent of the Wind River Project (or Riverton project), lands thought to be irrigable in 1917. The Shoshone Indian Reservation is located on the south side of the Wind River (Reclamation Service 1917).

To fund these studies, the Service reached into a pot of Indian Service funds inadvertently provided by lands across the river, justifying it by noting that “A certain interest is retained by the Indians in the ‘ceded-land’ portion of the reservation” (Reclamation Service 1917, 18). A sum of $2000 was appropriated for irrigation investigations, and another $5000 followed in 1918. Survey results, though still optimistic, were sobering: only 130,000 acres, not 265,000 acres were irrigable. It would cost “a little less than” $29.50 per acre to develop without
sublateral distribution, less extensive networks of water distribution, and $38 with sublateral distribution. The amount of clay in soils would require drainage systems at a cost of between $2.50 and $15 per acre. The project would cost well over $5.7 million divided between three different units (Figure 2.13) (Reclamation Service 1917).

Figure 2.13 Three original units of the Riverton Project, 1917. Shaded areas are labeled NO 1, NO2, NO3, in order of intended development (Reclamation Service 1917).

Regardless, the Secretary of the Interior authorized construction of the project, and provided $100,000 of initial funding through the Indian Appropriations Act of 1918, which funded Indian projects (Wyoming Reclamation Projects Survey Team 1963). The Reclamation Service carried out work on behalf of the United States Indian Service so additional funding was supplied
through Indian Service appropriations until 1920. The Reclamation Service then took over the project and its own funds were used (Bureau of Reclamation 1952, Appendix I, 5).

Construction was slow, and required large machinery and excavation (Figure 2.14), particularly in the depth of Wyoming winters. Drag-lines were brought north from the Rio Grande irrigation project and had to be rigged with kerosene water heaters and then coal-burning laundry stoves when the kerosene heaters failed (Bureau of Reclamation 1926, 19; Autobee 1996). Snow “cut the lubricating grease from the gears with astonishing rapidity” and concrete would not properly settle (Bureau of Reclamation 1926, 19-20).

The Diversion Dam, the centerpiece of the entire project, was finally completed in 1923 (Figure 2.15), the Wyoming Canal in 1924, and Pilot Butte Power Plant in 1925 (Figure 2.16) (Autobee 1996).
Water was finally ready for project lands in 1925 (Wyoming Reclamation Projects Survey Team 1963, 12), almost 20 years after the original land opening, and only enough for 1600 acres west of Pilot Butte Reservoir and its partner power plant. H.D. Comstock, project superintendent in 1925, wrote that by this time, many settlers had been compelled to abandon their land and go home (Bureau of Reclamation 1925, 51). Only one owner immediately made use of the
water to irrigate 80 acres of oats (51) and only 30 people lived in the town of Pavillion, not including those living in Reclamation Camp (Harper 1924-1925).

Figure 2.16 Map of irrigation canals. Wyoming Central Canal (originally Wyoming Canal #2), the westernmost portion of Wyoming Canal, Pilot Butte Power Plant and the Pilot Butte Canal were the earliest irrigation developments of the Riverton Project.

There was no demand for land in 1925, and little for water, thus all construction was halted between 1925 and 1928 (Wyoming Reclamation Projects Survey Team 1963, 12-13; Bureau of Reclamation 1925, 55). H.D. Comstock wrote a letter to the land owners informing them of the halt in construction and
other matters, warning, “If you do not carry on your share of the work by
developing your land, the project is and will remain a failure” (Bureau of
Reclamation 1926, 45).

The next public notice of opening for settlement was issued March 3,
1926, for 60 farm units (Wyoming Reclamation Projects Survey Team 1963, 18).
This time applicants were required to have at least two years experience in
farming and $2000 cash or assets and “must be satisfactory in respect to
character and industry.” Preference was given to servicemen (Bureau of
Reclamation 1926, 45). In 1929, only 19 farmers were watering 1075 acres.
There was little justification for government expense, and construction was halted
again between 1931 and 1935 (Wyoming Reclamation Projects Survey Team
1963, 12-13).

Figure 2.17 Riverton Project homestead after one year of settlement. Caption
reads, “From Sage to Civilization”. Photo courtesy of the Bureau of Reclamation
Riverton Project History, 1940.

Finally, things took a turn. The Great Depression benefited the project as it
forced people into new lifestyles, and moved them around the West. The number
of settlers and croplands began to grow. In 1930, 22 settlers irrigated 1,207 acres; in 1932, 52 settlers irrigated 2,809 acres; in 1935 212 settlers irrigated 14,947 acres; and by 1938, 25,905 acres were irrigated by 349 settlers. Crop values grew to $1.5 million by 1943 on 38,136 acres (Bureau of Reclamation 1943, 15; Bureau of Reclamation 1940, 35). In 1939, all 260 units of the First and Second Divisions of the project had been filled through six different land openings (Autobee 1996). A large portion of the project was finally settled. Small homes and agricultural fields began to transform expanses of sage (Figure 2.17 and Figure 2.18).

Figure 2.18 Early croplands and hayfields. Riverton Museum, Valley of the Three Rivers Collection.

When looking back over the Riverton Project, in 1963, the Wyoming Reclamation Projects Survey Team writes:

The development of the Riverton Project was accomplished in a haphazard, stop-and-go manner pressured by political influence. This manner of project development with its lack of order, coordination and objective study of all of the physical factors involved prior to construction is not conducive to the creation of an ideal irrigation enterprise; nor does it, in some instances, lend itself to a determination of the relative
responsibility for the various problems that plague this project…” (1963, 186).

Yet it is hard to place individual responsibility when everyone played a role in dreaming profit out of arid lands and dreaming big. The settling of Riverton was a metaphor for the new land ethic on the north side of the river. Individuals went to great lengths to stake an area of the West for their own. Riverton, just as soon as the town was named, became a place where a man arranged for lumber to be hauled to another man’s lot in his absence, and declared it his own. Another tried to jump a claim by depositing a whole shack onto someone else’s land (Lander Clipper 1906a; Chenery 1916) and people allegedly guarded their lots with guns (Goodman 2002). Riverton was a place where “Don L. Johnson showed that he was a worthy citizen and a hustler by bringing out a water wagon on Tuesday and he is now busy supplying the citizens with good water from the river” (Riverton Chronicle 1916, Reprint from 1906). A strong ethic of private property and individual profit amidst unrealistic dreams was more to blame than any individual. Inequities were part of the lottery.

Yet it was not as if no community ethic existed. When in the fall of 1923 the sugar beet harvest was still in the ground, snows set in and farmers panicked “…many of the city’s most sedate and staid business and professional men could be seen this week digging and manicuring beets despite the prevalent cold weather and blanket of snow that covered the fields adjacent to Riverton.” Schools declared afternoon holidays and students were sent to the fields “to participate in the harvesting activities and enriching their private exchequers,
Besides rendering a real valuable service to the community” (Riverton Review 1923). What was best for the region was best for the pocketbook and for the land. The land and its resources were there for the taking, more for those who could mastermind and afford it.

Fremont County had grown from a population of 5,357 in 1900 to 10,490 in 1930. Three towns had appeared: Riverton, which had grown from 483 people in 1910 to 1,608 in 1930; Shoshoni, which had decreased from 604 after the land opening to 263; and Pavillion, not yet large enough to register on the census, but the center of work camp for the Irrigation Project (Bureau of the Census 2000a).

The South Side of the River: On the south side of the river, there were no grandiose dreams of irrigation enterprise; people did not gather to rush the town site of Arapahoe and stake a claim, and no wealthy Shoshone or Arapaho moved in to save the day. Rather, irrigation development limped along and communities grew organically and disparately from the side of the reservation where they originally settled. Shoshone people tended toward the mountains, with Ft. Washakie as their hub, and Arapaho people settled the plains with loosely scattered communities of Ethete and Arapahoe. Population was rural and dispersed. The population of the tribes grew rapidly from 1,403 in 1910 to 2,416 by 1940 (Bureau of Indian Affairs 1950, 1).

Fowler suggests that settlement patterns along the Little Wind and Big Wind Rivers evolved from two original encampments, those of the Upper and Lower Arapahos, followed by the more dispersed encampments of extended
families. The Upper Arapaho settlement became Ethete, named “the good place” and Lower Arapaho became the Arapahoe community. The community of Arapahoe allegedly ended up with an “e” on the end because it was misspelled when the post office opened, and the spelling stuck. It helped to differentiate between Arapaho people and people who lived in Arapahoe (Iva Moss Redman personal communication 2009). The Shoshone Agency, various missions, Ft. Washakie and the Arapahoe Sub-Agency became regional hubs.

Fowler (1982) quotes Superintendent E.A. Hutchinson as reporting that many Indians had leased their allotments to whites for a pittance and were (1917) “aimlessly drifting, Micawber like, waiting for something to turn up.” Leased tribal income, as well as wage income was often funneled and diverted by the agency, for the hospital, agency salaries, and even the agency’s telephone line (133-134). Wage labor was often paid in merchandise, not cash, at the agency store, where tribal members never saw their accounts. Allotment sales and leases were handled in the same manner; money orders were given rather than cash, much to the frustration of recipients (133). In 1920, most tribal homes were canvas tents or shelters made of grass (134).

There were stark differences between Arapahos along the lower Wind River and their Riverton neighbors across the river. Fowler writes, “The fabric of Arapahoe social life was held together by reciprocity and redistribution” not accumulation and profit. When the Arapahoe community hall was built, for example, tribal members all stacked hay in communal stacks, which were sold to purchase building supplies (139). In 1914, Arapaho Sam Wolfrang protested the
distribution of tribal income to individuals who wished to farm and ranch by saying, “There is blind and widows and cripples who do not benefit by it. No one except a few of the able bodied men [benefit] by expending this money in such work…Let the Indians, each and everybody as a tribe get an equal share of these monies” (140). The tribes had always operated communally, and this ethic would not disappear with the new economy; it would adapt.

Between 1925 and 1933, little work was done on the Wind River Irrigation Project, which had been surveyed in 1900. Five irrigation units had been planned and developed, in part, with Second McLaughlin moneys. The Public Works Administration work relief program during the Great Depression authorized construction of water storage on the reservation in the 1930s, and constructed the most prominent feature in the Wind River Project, Washakie Dam, as well as the Dinwoody Canal. Since this period, efforts have focused on operation and maintenance, not expansion (Fandrich 2007).

The story of irrigation and settlement on the diminished portion of the reservation can perhaps be told as much by what was not constructed and settled as by what was constructed and settled. Two reports were sent to the 64th Congress in 1916 outlining irrigation plans in the Basin, one by the Indian Service, which detailed plans on the diminished reservation, and the other by the Reclamation Service. The Indian Service document spans 14 pages and outlines an irrigation project with a cost estimated at $1,118,339 with an additional $41,190 for an Indian project on the ceded portion of the reservation. The
Reclamation Service proposal is 90 pages long, and estimates expenses at $5,774,000 (Indian Service 1916a; Reclamation Service 1917).

Over $754,000 of the $1,118,330 in expenditures proposed by the Indian Service was slated to fund the proposed Wind River Ditch (Figure 2.19), a ditch extending from the Wind River to land between the Little Wind and Big Wind Rivers, “agricultural land of the very best class” (10). The ditch had been planned for at least two years; the Indian Service had already received an approved application from the State for water rights to 32,000 acres of Indian land that would be watered under this ditch. “The 32,342 acres of irrigable land under this project is nearly all high bench land which has been proved to be the best farming land upon the diminished reserve…”(12).

In 1915 Wyoming Congressman F.W. Mondell wrote to the Commissioner of Indian Affairs, “Permit 663c, for the Big Wind river ditch, also expires Dec. 31st. No considerable amount of work has been done on this ditch, which is a very important one, as it will water over 34,000 acres of fine land, a large portion of which is allotted.” Mondell visited the State Engineer’s office in Cheyenne and urged the authorities extend this water right three years (Mondell 1915a).

A correspondence following shortly thereafter, again to the Commissioner of Indian Affairs reads:

It is my present purpose to introduce a bill at the beginning of the coming session and make a most earnest effort to secure its passage, providing for the construction of this ditch. The arguments for the construction of the ditch are many: 1st. The ditch would water a very fine tract of land of nearly 35,000 acres at an estimated cost of approximately $10.00 per acre. 2nd. The land is very largely allotted to the Indians and cannot be used or
utilized by them until it shall be irrigated as it is essentially arid and will not raise crops without irrigation 3rd. If the water right for this ditch is allowed to lapse, it is likely to become prior and subsequent to other water rights both in Wyoming and Montana, which will necessitate the building of large and extensive storage works for the irrigation of these lands when they are finally irrigated (Mondell 1915b).

Figure 2.19 Map of proposed Indian ditches. An Indian Service report to Congress, 1916, allots the majority of its budget to the proposed construction of the Wind River Ditch, which was never completed (Indian Service 1916b).

In contrast, the Reclamation Service report proposes scrapping the Wind River Ditch and gutting its funds. Soil problems were already proving problematic, and required extra infrastructure to irrigate. The report reads:

It is possible that the proposed ‘Wind River Ditch’ in the diminished reservation may not be constructed. This ditch has a
Thus, the proposed ditch on Indian lands would be swapped for water rights and to pay for the correction of soil problems north of the river.

To be fair, it was not unusual for irrigation plans to far exceed possibilities. The Fremont Canal, part of irrigation plans on ceded lands, was never built. What is striking in this case is lack of equity in the division of funds between the two sides of the river. Tribes were often used as an excuse to earn funding for more irrigation, while they saw little reward. Regardless, and for better or for worse, all of these plans overlook some basic cultural differences in Basin water use: the tribes were never enthusiastic irrigators.

**Land and Water Use**

**Indian Farming on the River’s South Side:** Early extension agents were pulling their hair out:

This season has been a favorable one for extension activities and the production of crops as far as climatic influences are concerned, but the story in regard to the inclinations of our people is a far different one. Interest is lost in farming and our people are more and more taking to the camps and neglecting their farms (Extension Agency 1935, 1).
The agent rants on, “…their money is spent for old cars and gasoline and in far too many instances for whisky. In short, we are just merely riding along and taking no heed of the day when the change must come and we must go back to men of a self sacrificing basis as far as labor and income is concerned.”

When tribal members farmed successfully, the agency treated them as exceptions (Figure 2.20).

Figure 2.20 Shoshone farmer. A 1935 Extension Agency Report caption reads, “Tobie Higgins in his splendid wheat field. He is a Shoshone who believes in sticking with the farm”. Photo courtesy of the Denver National Archives.

Reasons for lack of Indian farming are complicated, but several factors were involved. Most obviously, quality of irrigation infrastructure differed from that of the north side of the river and lack of capital was a serious problem. The 1926 land opening requirements on the Bureau of Reclamation Project on the north side of the river specified:

Each applicant must possess health and vigor, and have had at least two years actual experience in farm work and farm practice. He must have at least $2000 in money free of liability, or the equivalent thereof in livestock, farming equipment, or
other assets deemed by the Examining Board to be as useful to the applicant as money (Bureau of Reclamation 1925, 35).

Elwood Mead’s “Opportunities for Farm Ownership on the Riverton Irrigation Project” (1927) lists the costs of farming equipment, including a farm wagon ($200), farm truck ($170), disk harrow ($65), walking plow ($27), mowing machine ($105), drill ($140), stacker ($150), binder ($270), manure spreader ($214), cream separator ($110), and cook stove ($45) (Mead 1927, 8). Just a few of these items cost far more than the average annual income of one family on the reservation, which the 1934 extension agency report estimates as $550. Supporting a farming operation, in most cases, was not possible (Extension Agency 1934, 4).

When John Collier addressed the Plains Congress and pressured changes in Indian policy (1934) he emphasized a second major deterrent to Indian farming nationwide, the “heirship problem,” a direct result of land allotment. When it became clear that tribal land losses were extreme under the allotment policy, the Allotment Act was finally repealed under the Indian Reorganization Act in 1934, which reformed Indian policy. Allotted trust lands could no longer be bought, sold, or divided which—predictably—created confusion as allotments passed from generation to generation. When allotted lands were passed on from one person to the next without specifying a direct recipient, heirs received “undivided shares” of the allotted land. The number of land owners continued to grow, making it more and more difficult to farm the land. “Now let us get it clear,” Collier stated, “…the situation has to get worse
every year as the original allottees die. This complicates this crazy quilt as heirship holdings increase year by year. Nothing can stop it because people insist on dying. We cannot stop them…” (Deloria 2002a, 33). In some cases, heirship was not a problem, but Wilson cites one example in which two allotments, and 216 acres total, had an excess of 100 heirs (Wilson 1973, 272). Collier found an heir who had just 1.1290 percent ownership of an allotment (Deloria 2002a, 33). In these cases, an heir who wished to farm the land was required to contact each other owner and receive consent, which was difficult at best, and sometimes impossible.

Delinquent Operation and Maintenance (O and M) charges were an additional financial deterrent to farming. Following the Second McLaughlin Agreement, more government funds were appropriated for larger scale irrigation. When the Wind River Irrigation Project was funded in 1905, the five units of the project absorbed many of the earlier ditches (Gerharz 1946, 6). Second McLaughlin funds were insufficient to cover the expansion. As a result, landowners were charged operation, maintenance and construction charges to pay for the irrigation expansion whether or not irrigation water was used. Delinquent charges became a lien against the land (Bureau of Indian Affairs 1950, 5; Wilson 1973, 295). These O and M charges encouraged land owners to lease their lands when that option became available in 1919, rather than accumulate charges (Wilson 1973, 295). According to Wilson, in 1912, 11,200 acres of irrigated land were cultivated by tribal members; in 1918 this acreage dropped to 7,359 because of new O and M charges. In 1919, when it was
possible to lease land, 20,807 acres were irrigated, only 7,000 by tribal members (1973, 296). He concludes that the development of the Wind River Irrigation Project caused the amount of irrigated land used by Indians to decrease, not increase.

Superintendent Stone, (1944, 5) reported that in 1940 “…for every acre farmed by the Indian farmers, non-Indians farm 1.5 acres. For every acre of Indian pasture, the non-Indian has 1.2 acres. The Indian pasture was worth $2.12 per acre; the non-Indian $5.80 per acre. For every dollar of Indian crop value, the non-Indian crop value was $5.00.” He went on to write:

The crop census for 1942 disclosed that during that crop year the average farm of the Indian family contained 26.2 acres of cultivated land and 25.3 acres of pasture, while the non-Indian family farmed 66.7 acres of cultivated land and 35.2 acres of pasture. The Indian family had an average income of $500.07 from crops raised, while the non-Indian family had an income of $2,063.73 from the same source. In other words, an Indian family farming an acreage approximately half the size of the non-Indian farm, has an income of only one-fourth the income of the non-Indian family (10).

Given the circumstances, it hardly made sense to farm, but focus on economics and lack of infrastructure avoids a central point. Much to the disappointment of eager extension agents perhaps Shoshone and Arapaho people did not want to farm (Figure 2.21).
Indian Ranching: In the early years of the reservation, range lands were leased to white cattlemen, generally for one or two cents an acre for five year periods (Bureau of Indian Affairs 1950, 10) but Stamm (1999, 207) suggests that over 10,000 unauthorized sheep and cattle roamed the reservation. More formal means of accounting for grazing were established in 1912, but these were haphazard. More non-Indian owned stock than Indian-owned stock grazed reservation lands through the early 1930’s (Wilson 1973, 323).

Early treaties often involved cattle in exchange for lands, but none of these herds were maintained over time by the tribes or agency. In 1913, tribal funds were used to establish a beef cattle herd which remained a communal herd until 1927, when the Indian Bureau pushed individual enterprises, and the herd was liquidated (Bureau of Indian Affairs 1950, 11). Wilson notes a pattern; when
the cattle were issued to individuals, as in 1880 and 1927, “it was not long before most of them were in the hands of white people” but when they were issued to the tribes as a whole, the herd was maintained.

The government’s demand for an Indian private property ethic began to wane in the 1930s when it became evident how detrimental the Allotment Act had been. The Miriam Report and the Indian Reorganization Act worked to keep land in tribal ownership, not to further deprive tribes of lands. Livestock cooperatives were introduced with much success after 1932 and more tribal members ranched. The 1934 reservation extension agency report lists that 551,184 acres were grazed by white-owned stock and 244,138 by Indians (4); 152 Indians owned 3174 beef cattle; and 46 people owned 8303 sheep (12). This situation would reverse over the next decade, when 22,03 cattle and 25,871 sheep were Indian owned, and reservation lands were almost completely grazed by Indians (Bureau of Indian Affairs 1950, 13).

While extension agents vent their frustration over farming, they write, “The Indians are inclined toward livestock work” (Extension Agency 1934, 33) and, “The livestock portion of the program is moving on remarkably fast. We are not only getting more stock but our people are fast learning the act of caring for the animals. The two livestock associations have rallied to the cause of bettering conditions for running the livestock and properly utilizing the range” (32). In the 1935 report, agents noted:

It is indeed with a great deal of pride that the Association members can look upon the financial record which, it is thought, is not paralleled in the Indian Service. For five years this
organization has hired men, bought supplies, paid out large sums of money and twice a year has cleared the slate. Not only this, but at the same time the members have been paying to the government, through the reimbursable channels, substantial payments to take care of the original cost of the sheep. To date many of the members have paid out their reimbursable obligations to the government and all of them are nearing payment in full (Extension Agency 1935, 18).

The tribes successfully entered the lamb and wool industry (Figure 2.22).

Wilson writes, “…it never occurred to the government that the Indians would eventually become ranchers once they were moved onto the reservation…” but ranching was far more successful than farming. Most Indian crops were raised as part of ranching operations; most Indians—for a number of reasons—were not inclined to farm (Wilson 1973, 321, 312).

Figure 2.22 Ranchers and sheep corrals. Ranchers separate sheep among members of the cooperative at reservation corrals (Extension Agency 1935).

Ranching on the North Side of the River: Most of the lands on the north side of the river were not irrigable and, moreover, they had the potential to be instantly utilized after the land cession: 325,000 acres were withdrawn for the
reclamation project but 1,480,000 acres were ceded. While all eyes focused on developing an irrigation dream, local stock owners turned their animals loose on the rest of the ceded lands at no charge. In 1912, 100,000 head of sheep and 3,500 head of cattle were trespassing on ceded lands; “…the over-grazed condition of the range became so alarming that it could no longer be overlooked” and the Bureau of Indian Affairs took over management of the range. Permits were then required for non-Indian owned cattle, but ranchers were only marginally supervised by the BIA (Stone 1944, 11; Bureau of Indian Affairs 1950, 11; Wilson 1973, 323).

Jacob A. Delfelder, a celebrated Wyoming stockman, moved to Riverton in 1913. The Riverton paper announced his intentions of building “mammoth stock yards” north of town, equipped to hold 50,000 sheep and a large number of cattle along with its own railroad spur, “Welcome to Riverton Mr. Delfelder, and may your stock multiply is the wish of the Republican” (Riverton Republican 1913). The newspaper reports that he purchased a house on the 2nd of May and was mayor by the 16th. He bought 80 acres for a city park the following November and the paper declared, “The minute that Mr. Delfelder proclaimed Riverton as his home, that feeling of exhaustion which had long gripped Riverton in its deadly grasp was broken…” (Riverton Review 1913). The ceded lands were treated as public domain, there for the taking and profit making (Figure 2.23).
In 1928, more formal means of permitting were instituted and “at least some form of control” was developed over grazing. The Forestry Division took over range management in 1930 under the direction of the Secretary of the Interior and new regulations were prepared alongside objectives that would protect “…the interests of the whole Indian people against unfair competition and…the exploitation…of open range by more aggressive individuals” but the new regulations were not enforced (Missouri River Basin Investigations Staff 1950). While 1,500,000 acres of range land were used by non-Indians in 1930, only 300,000 acres were used by Indian operators (Stone 1944, 12). Range lands on the north side of the river deteriorated for almost 30 years.

Indian lands were not unique in their overgrazed state. As Larson writes of sheep losses blamed on woody-aster, “That sheep were starved into eating poisonous plants is a commentary on overgrazing, which was widespread on the
public grazing lands and which was accepted as inevitable by informed observers of this period" (1965, 369). Cattle and sheepmen had been powerful for a number of years in Wyoming and played strong political roles both in the state and regionally in their industries. The 1,940,021 sheep in Wyoming in 1898 nearly doubled to 3,827,000 in 1914 in the same period that cattle decreased from 706,000 to 583,000. Larson suggests that these estimates are low, but indicative of markets. Sheep adapted more easily to variable climates, and played a strong role in the national wool industry until World War II, when competition from foreign markets resulted in huge stockpiles of wool, and the cattle market again grew (367-368).

**Farming the North Side of the River:** Farming limped along on the north side of the river until the end of the Great Depression and World War II when yields and markets grew. The Bureau of Reclamation’s 1937 report reads, “yields have been rather poor in the past but indications are, as evidenced by yields for 1937, that some of the farmers have solved their problems” (30). The only crop that produced similar yields between 1936 and 1940 was alfalfa (2.2 tons). Alfalfa seed and sweet clover seed decreased while oats, beans, sugar beets, barley, wheat, potatoes and corn all increased, in some cases dramatically; 88 bushels of potatoes per acre surged to 180 by 1940 (Bureau of Reclamation 1940) (Figure 2.24).
Figure 2.24 Sugar beets are prepared for shipment. “The Hinkle Beet Dump” prepares sugar beets grown on the Riverton Project. Riverton Project History, 1940.

Farmers shifted crops according to fluctuating markets, which were often unpredictable. Prices of potatoes, grains and beans, for example dropped in 1937 when new crops entered the market in other parts of the country (Bureau of Reclamation 1937, 29). In 1940 beans started high and dropped for fall harvest. Barley gained, oats remained the same and wheat dropped. Butterfat was 31 cents per pound in January, dropped to 24 cents in May and rose to 35 cents in November. While some of the price fluctuation was due to local competition, it was also attributed to activity on Eastern and West Coast markets (Bureau of Reclamation 1940).

Transportation networks were emphasized in every annual report. “There is a great need for new roads and for improvement on existing roads,” the 1939 project report reads (29) and the 1940 project report emphasizes, “there is a great need of more surfaced farm to market roads forming a network over the
entire project and interconnecting with the primary roads” (39). The main shipping points were Riverton and Shoshoni, where crops joined a larger network of distribution on the Chicago and Northwestern Railroad. Sugar beets were transported to Bonneville and shipped for milling via the Chicago, Burlington and Quincy Railroad. While a sugar beet mill was planned for years in Riverton, its construction never came to fruition; sugar beets were shipped north to the mill in Worland.

**Trees to Ties:** As farming and ranching followed different trajectories on the north and south sides of the river, the railroad industry used the river itself to transform lumber to railroad ties, and resource to capital (Figure 2.25).

![Figure 2.25 Wind River tie drives. Ties float from Dubois to Riverton on Wind River spring flows, a) downstream of diversion Dam and b) ties flow over the spillway of the dam, and are funneled downstream by the tie hacks. Photo courtesy of the Dubois Museum.](image)

The Wyoming Tie and Timber Company based itself in the headwaters of the Wind River, near Dubois, in 1914, where it began crafting replacement railroad ties for the Chicago and Northwestern Railroad. The ties maintained the 700 miles of track from Lander to Blunt, South Dakota, the western half of the
Chicago and Northwestern lines (Goodman 2002, 1). The company employed mainly Swedes and Norwegians in the early years, who cut timber all winter, transformed logs into railroad ties, stacked the ties in piles along the river until high water in the spring, and then floated the ties 100 miles down river to Riverton.

The tie drives are a romanticized part of the river’s history: the danger of getting caught on a “sweeper” and left hanging from tree branches while straddling ties like a boat and floating them down the river; developing “squeak heel” from standing in the river for days on end; and the week-long revelry that followed the drive in Riverton (Goodman 2002). But beneath the adventure and tanned strong bodies were the hardships endured by the labor force of resource based capitalism. One tie hack spoke of the winter days,

Way too hard. I’m so glad I got away. I’d get up at 5:30 to feed the horses, walk up behind the sled to take off my sheepskin coat and inside of five minutes, the sweat was running in streams – you could feel it. I can’t begin to tell you how hard it was. No wonder they got alcoholic. I guess we didn’t know any better – but hard work, hard work. The mind doesn’t go anywhere or expand. We didn’t know any better (Wind River Historical Center 1999).

When the tie hacks tried to unionize, the Wyoming Tie and Timber Company shut down for a year and defeated the effort (Pinkerton 1981, 118). The tie drives ran because they were a profitable business.

Timber resources were rapidly depleted near the DuNoir headquarters (near Dubois), so the company moved its operation to the vast stands of timber in the Warm Springs Creek Valley in the late 1920s. An extensive flume system
and steep road was constructed to transport ties 2000 feet to the Wind River at the rate of 4,000 ties an hour (Goodman 2002, 6-11). A tie treatment plant in Riverton was completed in 1935, which soaked ties in zinc chloride and doubled the life of ties (1,65). The Wind River tie drives became the largest in the nation; 670,000 ties a year were floated downstream following a winter of chopping and hewing trees (Figure 2.26).

Figure 2.26 Railroad ties piled in Riverton ready for stacking and shipment. Wyoming State Archives.

The tie drives undoubtedly contributed to the local economy. The later tie drives employed 80 to 100 men, and paid them more than double the average wage for the five to nine weeks the drive required; the treatment plant employed 50. Yet the tie drives, like overgrazed ranch lands, utilized public resources. Wyoming Tie and Timber as well as the Chicago and Northwestern Railroad
profited from the public domain at considerable long-term ecological cost. While little discussion focuses on environmental impacts in the Wind River Mountains, timber harvests in Colorado Front Range forests left “a wilderness of stumps” (Wohl 2001, 90). Rivers were altered to facilitate an easier drive: obstacles were often blasted, and the effect of so many ties flowing at once “had an effect similar to that of running a giant bottle brush down the rivers” (89-101).

**A Dynamic Environment**

In the 1905-1906 State Engineer’s report, engineer Clarence Johnston writes of Wind River Basin lands, “The water supply is ample, cheap storage reservoirs can be constructed as a further guarantee for the supply during the late months of summer, the soil is uniform and of first-class quality, and the country is well sheltered” (State Engineer 1905-1906, 51). The Wyoming Central Irrigation Company advertising brochure reads, “Rich soil, perpetual sunshine and abundant water under absolute control of the Farmer…” (Wyoming Central Irrigation Company 1907, 2). Yet by 1939, it was clear that irrigation would not be as easy as planned, in part because the environment was not a blank slate to be transformed by human will. It was dynamic and posed unanticipated problems for new agriculturalists. For example, the reservation’s Extension Agency Report from 1934 details 16 rodent control demonstrations, two predatory animal control demonstrations, 250 insect control demonstrations and specifies that grasshoppers were combated with a two ton mix of bran and arsenic (Extension Agency 1934). Pests were not part of the irrigation plan. Neither were floods and
ice flows. In 1924 the Badwater tributary to the Wind River jumped its banks and tore out roads. Ice ripped up bridges in 1929 (Figure 2.27).

Figure 2.27 Unexpected flooding and ice flows. Lander Museum.

In addition to environmental events that were not anticipated, because they had not yet been observed, human changes elicited unpredicted environmental response. In 1933 the U.S. Indian Irrigation Service reported that accumulated salts in soils were killing crops. They note that irrigation exacerbated the problem, “Considerable areas of seeped land and alkali soil are found in the valley and under constructed works on the irrigation projects. Some of the soils showed signs of salt accumulation (greasewood flats) before water
was applied to the land, but the affected areas have grown considerably since irrigation has been practiced” (29).

Likewise, the Annual Report of Extension workers on the Wind River reservation, 1934, calls for urgent action to eradicate weeds. It estimates 75 acres of white top, 75 acres of Canadian thistle, 50 acres of Russian knapweed 50, and 80 acres of wild morning glory and notes in the bottom margin: “there is urgent need for something to be done about our weeds. They are spreading rapidly. The situation is alarming” (13). The word “nothing” is typed on a line reserved for money spent on reservation weed control, but one weed demonstration was conducted using carbon bi-sulphide on one sixth of an acre. The report later reads, “There are on this Reservation now upwards of 200 acres of noxious weeds. These weeds cannot be checked or destroyed unless chemicals can be secured to fight them with. They are spreading each year both by seed and root sprouts. There should be something done along this line. All that is being done now is to mow the plants where they can be gotten at with mowing machines” (34).

The environment was more dynamic than anticipated. Human-environmental relationships were changing, and so was the basin as a whole. The developing human-environmental landscape, or “hybrid landscape” was not just a result of dreams gone awry or mistaken metaphors, though they certainly played a role (Fiege 1999). The physical changes were manifestations of more invisible power dynamics, cultural preferences, economic markets, and government policies. Some were local, but many were not. Whether they were
government preferences or economic trends, outside forces shaped these hinterlands. The Wind River basin was a hybrid mosaic of myriad influences.

Vast differences in capital investment, new economic networks brought by settlers, and power dynamics between government bodies, for example, produced very different settlement patterns on the north and south sides of the river. Fragmented irrigation project lands on the north side of the river, divided into units by government requirements, were heavily subsidized, initially with Indian funds. The town of Riverton was platted by officials of the state. While it certainly did not evolve as planned, the resulting landscape mosaic was still an organized network of town lots and acreages, first drawn on maps. The south side of the river differed in capital investment, planning, in its relationship to growing economies, but more than anything, in its relationship to power. The Indian Service failed to fund the Wind River Ditch and maintain reservation water rights, the tribes’ were left out of the networks that supported growing economies (for example, the tie drives), and they were forced to succumb to poorly planned federal policies, such as allotment. In many instances, tribes lacked access to power; yet the tribes maintained a different kind of local control. They held fast to their preference to ranch, not farm; they still lived in family units and cultural groups and lived according to their own value systems. Thus, the settlement landscape on the south side of the river displayed its own mosaic of lost lands alongside allotted lands and vast tracts of tribally, communally owned land.
These dynamics were at the root of human-environmental change. Agricultural industries were tied to economic markets, which related to both crop preferences and vegetation change on overgrazed lands. Land allotment led to the heirship problem, which prevented agricultural activities, and vegetation changes, on reservation lands. The two sides of the river developed into their own “hybrid landscapes” composed of human-environmental relationships of floods, predators, weeds and economic markets, power plays, and cultural preferences. Different relationships produced different dynamic geographies.

**Sharing the Basin: 1939-1976**

This study and detailed studies which will follow it on sub-areas of the basin are based on a belief in Man’s ability to cope successfully with the challenge of a difficult natural environment once all the facts are faced. It is important to face these facts and accept the challenge if we are to create the particular kind of production and social services to which the area is uniquely suited and by which it can contribute most to the larger life of a great river valley and a strong nation (Bureau of Land Management 1947).

Figure 2.28 A truck sprays field bindweed in the Goggles allotment, 1953. Photo courtesy of Bureau of Indian Affairs, Ft. Washakie.
In a dramatic reversal of the trend in which tribes lost land, all unsettled lands on the north side of the river were returned to the tribes in 1939, excluding the Riverton Irrigation Project lands. The Shoshone Indian Reservation became the Wind River Indian Reservation and the Wind River no longer clearly demarcated Indian and non-Indian lands. Substantial lands were again owned by the tribes on the north side of the river, several thousand acres of fee lands were owned by non-Natives on the south side of the river, and additional land was leased. A 1952 Missouri Basin Field Committee report emphasized that over 63% of Wind River Basin lands were managed by the Department of the Interior, which created a “departmental responsibility” for coordinating an “attack” on basin problems, but this estimate was vastly oversimplified for political ends (Missouri River Basin Field Committee 1952, 12, IV). These lands were tribal, allotted, fee, and leased lands, reclamation withdrawal lands that had sold and that had not sold, with an additional sum of lands owned by the forest service, the state, and privately. One would be hard pressed to find a more convoluted land ownership mosaic. Despite the ownership muddle, vast cultural differences, and growing tensions concerning the use of government funds, all of the residents of the region shared a common setting, were challenged with a similar set of environmental limitations, and experienced a landscape that was being transformed as a result of their cumulative actions. Many of these actions concerned the rugged and endlessly changing environment. All basin residents were experiencing the transformation of the landscape as a whole.
Boundaries and Legal Control

In 1939, an enormous shift took place on the reservation that reflected the federal government's changing attitude toward tribes. Nationally, sympathy was mounting for the state of affairs in Indian country. The Meriam Report of 1928 portrayed the deplorable conditions of Indians and elicited public outcry. Franklin D. Roosevelt appointed John Collier, a critic of previous Indian policy, as Commissioner of Indian Affairs, and Congress passed the Indian Reorganization Act in 1934. Tribes were allowed to establish their own governments, land allotment policy was reversed, reservation infrastructure improved, and available lands (previously ceded) were returned to tribes (Pevar 2002, 9-10; Deloria 2002b, vii-xvii).

Events in the Wind River Basin reflected this trend. The Shoshone Tribe received a settlement of $4.5 million from the U.S. Government for a breach of treaty stipulations. They had never received compensation for sharing their reservation with the Arapaho Tribe, which had received proceeds from land cessions and allotments as if it were a joint owner. After 12 years of litigation,
the Shoshone Tribe was awarded half the value of the reservation estimated at the time of Arapaho settlement, plus interest (Shoshone Tribe of Indians v. United States, 299 U.S. 476 1937). The reservation name changed to the Wind River Indian Reservation to recognize both tribes. There were certainly strings attached. Per capita payments were limited to expenditures on “equipment or supplies necessary to enable the Indians to fit themselves for or to engage in farming, livestock, industry, or such other pursuits or vocations…”; $125,000 was set aside as a loan fund; $1,000,000 was to be specifically used for the purchase of land, and the remainder was available for appropriation “upon the recommendation of the Secretary of the Interior, and with the consent of the tribe, for purposes of benefit to the tribe…” (387 Stat 1128 1939).

The most important part of this act was that all available lands on the north side of the Wind River returned to tribal ownership, excluding lands in the Riverton Irrigation Project (Figure 2.29). The size of the reservation more than doubled.

The Shoshone Judgment Fund had many other repercussions. Range lands on the north side of the reservation were allowed to recuperate; investigations of grazing conditions were made; and new livestock capacities were established. Just as significantly, many Shoshones now had access to farming and ranching supplies, and many asked for ranch assignments. As of 1942, $301,864 had been spent on livestock purchases from the Fund, $135,815 of that on range cattle. Livestock purchases far exceeded any other category of expenditures, including buildings and equipment and the Extension Agency
reported that 39 new homes were constructed in 1941 alone (Extension Agency 1940, 22-26, 29). The Wind River Cattle Association, for the first time in history, devoted its range units entirely to Indian use (Extension Agency 1940, 7).

Though the Arapaho Tribe did not share in the Judgment Fund, the Arapahoe Ranch was started in 1940 as a tribal enterprise with funds from a government grant. It operated on 300,000 acres of tribal range on both the north and south slopes of the Owl Creek Mountains where it still operates a successful ranching operation as a cooperative venture of the tribe (Bureau of Indian Affairs 1950, 12) despite what Superintendent Stone wrote of it in 1945, “It is contemplated that this operation will continue until the expansion of individually-owned livestock operations justify its curtailment” (1944, 39).

After 60 years of government pressure to civilize Indians through private property ownership (1868-1930), the tribes still operated cooperatively (1906-1939), in cases, and often successfully when they did so.

Boysen Dam: Gains in tribal lands north of the river, however, were partially offset by more losses of land associated with the Boysen Dam project. In 1950 another 19,000 acres of land was alienated from the reservation through a government taking for the construction of a reservoir and power plant just upstream of the Wind River Canyon. Congress approved the construction of Boysen Dam on December 22, 1944, which required 44,017 acres: 23,330 acres of tribal land, 2,550 acres of allotted land, 13,146 acres of non-Native land, and 4992 acres of government land (Missouri River Basin Investigations Staff 1946,
3). Lands were mainly grazing lands and riparian woodlands along the river, though “a minor amount of farming was practiced within the taking area” (Bureau of Reclamation 1951, 3).

Figure 2.30 Bottomlands flooded by Boysen Dam. Dam location marked in red. USGS aerial photography photo mosaic, 1948-1949.

Boysen Dam was part of the larger Missouri River Basin Pick-Sloan Plan designed to manage the river as a whole, balancing irrigation needs of the upper basin with flood control and navigation in the lower basin. It was a massive plan that included 107 dams to be constructed and maintained by both the Army Corps of Engineers and the Bureau of Reclamation. The plan disproportionately affected Indian lands (Lawson 1994, 20, 179-200).

In strict acreage, the amount of lands involved in the Boysen taking almost equaled lands returned to the tribes from the Riverton Irrigation Project. As it became apparent that several areas were not irrigable, the project area was reduced and lands were returned to the tribes. Over 10,000 acres had been returned by 1940, and another 70,500 by 1953 (Wilson 1973, 246). Unlike the Boysen lands, these were not riparian bottomlands.
Population and Settlement Patterns

In 1940, 16,095 people resided in Fremont County, which grew to 28,352 in 1970 (U.S. Census Bureau 2000b). Riverton outgrew Lander in the 1950s, and became the county’s largest town with 2,540 people in 1950 and 7,995 people in 1970. Its growth was attributed to the irrigation project, originally, followed by the development of oil, gas and uranium (Bureau of Indian Affairs 1960, 3). Shoshoni and Pavillion remained small towns for 30 years, with 226 and 176 people in 1940, and 562 and 181 residents in 1970, respectively. Crowheart, Burris, and Lenore became community centers in the upper end of the basin, but remained rural, with dispersed populations. The irrigation district population grew from 465 settlers in 1940 (Bureau of Reclamation 1940) to 1,781 in 1953 (Bureau of Reclamation 1953).

The reservation’s population was a modest fraction of the county population, totaling 2,621 in 1943 (1,314 Shoshones and 1,307 Arapahos) and 4,055 in 1968 (Bureau of Indian Affairs 1968b, 56). Yet the tribes managed 2.2 million of the county’s nearly 6 million acres of land, which became more significant as oil and gas exploration increased during and after World War II.

Shoshone and Arapaho communities remained distinct, the Shoshones still inhabiting westernmost settlement areas and Arapahos further east. Most Arapahos lived near Ethete, St. Stephens or Arapahoe while most Shoshone families lived near Ft. Washakie, along the Big Wind River near Morton and Crowheart, or on the highway to Lander. A Bureau of Indian Affairs report
(1968b, 15) reports 50 Arapaho homes in the Arapahoe area; 60 Shoshone and 4 Arapaho homes near Ft. Washakie; 36 Arapaho and 8 Shoshone homes near Ethete; 18 Shoshone homes near Morton and Crowheart; 11 Shoshone and 3 Arapaho homes near Lander, and 10 scattered homes. Thirty percent of Shoshone tribal members resided off reservation, and 16 percent of Arapahos, most of who remained in Wyoming (17).

Many tribal members used Shoshone Judgment Act funds to build houses. The Extension Agency reports (Extension Agency 1941) $90,421 in housing expenditures (23) and the construction of 39 new homes, 14 remodels and 11 new wells (29) noting, “The heavy demand for new homes with Shoshone Judgment Funds is now over.” Funds were also used to purchase tracts of ranch land along the Big and Little Wind Rivers, which had passed into non-Indian hands. The Bureau of Indian Affairs reports, “Ranch headquarters are widely scatted along the Wind and Little Wind Rivers and their tributaries” (Bureau of Indian Affairs 1968b, 2). In 1964 the Arapahos received almost $3 million in government funds, much of which was used to build new homes for its tribal members. In addition to these home building eras, low-rent housing units began to appear in the 1960s, the first of which was constructed in Ft. Washakie “to assist low income families in securing safe and sanitary housing” (Bureau of Indian Affairs 1968b, 55).
Land and Water Use

Land uses diversified between 1939-1975. Interestingly, the tribes maintained tradition while simultaneously investing in new industry. Tribal members hunted game and gathered berries at the same time as the joint tribes invested in oil and gas development on tribal lands.

In 1948, 12,500 fish were caught by Indians and over 70% of the Reservation population still consumed game during the year (Missouri River Basin Field Committee 1954b, 72). Likewise, the 1940 extension agency report indicates that 850 quarts of wild berries were collected alongside 50 quarts of strawberries and 42 quarts of raspberries (Extension Agency 1940, 8). Cottonwoods maintained their place at the center of the tribes’ ceremonial life; and willows and water birch played vital roles. In 1941, average income on the reservation was $1,203 (Stone 1944, 17) which rose to $4,368 by 1959. This was almost all because of oil and gas development on the reservation.

Extractive Industry: The oil and gas industry on the reservation roughly followed the Wyoming trajectory, dramatically rising during World War II: from 80,305 barrels in 1939 to 2,111,755 barrels in 1945. Rather than declining after the war, as did the Wyoming average, petroleum on the reservation continued to rise, reaching over eight million barrels in 1957. Natural gas similarly climbed from 65,322 thousand cubic feet in 1945 to 19,075,216 thousand cubic feet in 1971 (Seeland and Brauch 1975, 39). Since lands on the reservation were leased by oil and gas companies, tribes received royalties, which were divided
between each tribe and distributed as per capita payments. In 1945, royalties totaled $3267; by 1959, royalties totaled $2,267,501 (40). The median income of Wind River families (1957) was $4,368 (Bureau of Indian Affairs 1960, 28), still less than the $5,877 state average (U.S. Census Bureau 1960, Table 65); $2,475 of this came from royalties and leases (Bureau of Indian Affairs 1960). Oil output climbed steadily through the 1970s and became a critical source of tribal income. It was just as critical statewide, where oil and gas brought as much as agriculture, livestock, and tourism combined (Larson 1990, 510).

The uranium industry grew after World War II, as the Atomic Energy Commission looked for new sources. In 1953 uranium was found in the Gas Hills east of the reservation, where some the most productive mines in the state were soon developed (Larson 1990, 514). According to the Riverton Museum, “It was the uranium industry that transformed Riverton from a quiet farming community of 2,500 people into a bustling commercial center of more than 10,000” (Riverton Museum 2010).

Uranium was transported from the Gas Hills to what the Department of Energy calls “privately owned land that is located within the boundaries of the Wind River Indian Reservation” (U.S. Energy Information Administration 2005), though at least one family claims its land was taken by eminent domain (Catron 2010 personal communication). Regardless, a uranium mill was constructed just south of the Wind River and operated from 1958-1963 with the capacity to process 500 tons of ore per day, producing 3.4 million pounds of uranium concentrate under contract from the Atomic Energy Commission. Tailings piles
covered 72 acres 4 feet deep totaling 900,000 tons of mill tailings material (U.S. Energy Information Adminstration 2005).

**Agriculture:** Over half of tribal families were involved in some kind of agriculture in 1940; 273 of 586 resident Indian families had agricultural income, which totaled $226,827 (Extension Agency 1940). Most of this was in livestock sales and feed, including over 4000 acres of alfalfa, 4000 acres of wild hay and 2000 acres of oat hay. Vegetables only earned about $800 after expenses and in 1947, and cereal crops only $3,500 (Extension Agency 1940). In 1947, Indians still used only 7,000 of 21,500 irrigated acres on the reservation; the rest was rented or owned by non-Natives (Bureau of Land Management 1947, 16). The tribes, as a whole, preferred livestock over crops; never wholeheartedly embraced irrigation; and still relied on traditional domesticated foods. Agriculture still played a role in some portion of reservation livelihood, though less than other means of employment. By 1960, only ten per cent of tribal members reported agricultural income, while over 20 per cent of tribal members reported additional employment wages other than agriculture (Bureau of Indian Affairs 1960).

The Riverton Irrigation Project, meanwhile, grew from its prosperity during World War II. As experimentation progressed, agriculturalists found that some rotation of alfalfa, grass, oats, barley, wheat, clover, sugar beets, beans, potatoes, and legumes served as best cash crops, though certainly other vegetables and fruits were suited to smaller scale gardens (Bureau of Reclamation 1952; Harper 1924-1925). As farmers struggled to even make a
profit from these, many turned to livestock, or at least made livestock a large part of their enterprise. “Considering soil characteristics, climatic conditions, and adapted crops for this area, farming operations should tend toward livestock production with some limited intensive farming” (Bureau of Reclamation 1952).

By 1954, “About 80 percent of the irrigated land was devoted to the production of grain, hay, and pasture for livestock and about 20 percent was devoted to beans, sugar beets and miscellaneous crops” (Missouri River Basin Field Committee 1954b).

On Native and non-Native lands, everyone found themselves at the same conclusion: raising livestock and livestock feed made more sense than vegetables, with few exceptions. A 1947 land classification report notes that in the aridity of the basin arable and irrigated lands comprised just more than four percent of the total area. “Virtually all crops are grown under irrigation and most of them are closely related to the livestock industry” (Bureau of Land Management 1947, VI).

**Third Division Riverton Project:** The third, and final, Division of the Riverton Irrigation Project was authorized under the Flood Control Act of Dec 22, 1944, the same act under which Boysen Dam was built. The Riverton project had limped along for most of its history, but the Post-World War II years had been prosperous and the government was again willing to invest in plans that had taken almost forty years to develop (Autobee 1996).
Between 1947 and 1950 the government opened 7,000 acres in the Lost Wells and Pilot extensions of the Second Division, 6000 acres into the North Pavillion area, and another 7000 acres of the North Portal. Lands were opened through a lottery, and those with the lowest numbers were eligible to purchase land (Autobee 1996).

By 1951, it was apparent that seepage problems were worse than anticipated (Wyoming Reclamation Projects Survey Team 1963, 29) and a development farm was organized by the Bureau of Reclamation and the University of Wyoming to try to solve them. The exact opposite happened; the farm suffered a complete crop failure. Subsequent fertility studies in University of Wyoming greenhouses determined that “…there are still major problems of fertility, soil management, and irrigation practices that need to be resolved…” (Bureau of Reclamation 1952, 77). A new land classification found that much of the land originally thought irrigable, “is now beyond economic reclamation. In fact, it is estimated that the ratio of nonproductive land to good land is about 2 to 1” (Wyoming Reclamation Projects Survey Team 1963, 50). The new classification reduced irrigable acreages of some farm units “to less than economic family-size farms” and left settlers in a serious bind (Wyoming Reclamation Projects Survey Team 1963, 29).

In 1953, Public Law 258 offered an “out” to settlers whose lands were uninhabitable. Settlers were encouraged to either resettle on other public projects (Columbia Basin, Minidoka and Gila), or were given extra available land (freed up by those who left) and from the public domain (Wyoming Reclamation Projects
Public Law 258 may have stabilized the Riverton Project (Autobee 1996, 15) but not for long.

Continued soil problems plagued settlers who remained (Wyoming Reclamation Projects Survey Team 1963, 3); poor drainage in some areas led to excess salts; erosion carried away soils in others. In 1961, contract negotiations between the Bureau of Reclamation and the Third Division Irrigation District failed. The Third Division irrigators refused to enter repayment contracts with the government, claiming that the farms had been falsely advertised and misrepresented to settlers (no adequate living could ever be made on Third Division lands); land classifications had been dishonest and incompetent; drainage plans were insufficient; and that the Bureau knew when the project was settled that it would fail (Wyoming Reclamation Projects Survey Team 1963, 21). Conversely, the Bureau retorted that “News media, Congressional hearings and recriminations over technical shortcomings in Project design, some real and some alleged, have dramatized the problems which need correction…” (2).

The Wyoming Reclamation Projects Survey Team implied that problems resulted from political pressures urging the Bureau of Reclamation to open the project before comprehensive planning could take place. The settlers, and their lack of experience, were at least partially to blame for Third Division problems. The report noted:

… the desire to place World War II veterans upon farms led to improper screening and the selection of individuals without proper experience or incentives. The Survey Team feels
strongly that if new settlers take over farm units on the Riverton Project under any kind of adjustment program that Congress may authorize, the Bureau of Reclamation should be given the final authority in the selection of entrymen on the basis of realistic irrigation farm, education, capital, references, etc. (1963, 39-40).

They emphasized that Third Division settlers had received more help than any other. “It is interesting to note that settlers on the Third Division of the Riverton Project received settler assistance involving preferential treatment not ordinarily afforded applicants for homesteads on irrigation projects.” The report added that each settler received two 20 x 120 foot barracks from Heart Mountain Center of the War Relocation Authority; had access to the expertise of earlier successful settlers; land clearing was provided at $10 an acre reimbursable; and technical assistance was provided by the University of Wyoming Extension Service and the Bureau of Reclamation through an agent assigned to the Riverton Project during the early years of settlement (Wyoming Reclamation Projects Survey Team 1963, 21-22).

Ultimately, however, the government passed Public Law 88-278 in 1964, authorizing the government purchase of 22,000 acres and 78 units of the Third Division. Irrigators of the Third Division were bought out.

**The Wind River Irrigation Project:** The Wind River Irrigation Project operated under a fraction of the capital given to the Riverton Project. Irrigation infrastructure was vastly better on the north side of the river, and, because of settler requirements on the Riverton Project, settlers arrived with cash on hand for farming supplies and home improvements. On the Wind River Project, the
tribes struggled with basic needs, as superintendent Stone reports (1944). In particular, irrigation water was used as a supply for domestic water.

So serious is this factor in the life of the Ethete community that it has made migrants of the families which depend on irrigation ditches for domestic use and which are forced to move to the river when the water supply in the ditches is cut off. The result of this migration to a temporary community is that cases of sex irregularities increase, disease spreads, and juvenile delinquency involving the children in this particular settlement becomes a major problem (1944, 16).

Regardless of the financial differences between the irrigation projects, it is interesting to note the similarities. Like the Riverton Project, for many years water was available on the Wind River Project long before it was completely used. Farming was a difficult livelihood. Expenses were high and rewards were often low. On both projects, irrigation water was initially promoted, not sought.

In 1946, Gerharz stated his belief that, “The Indians do well working for someone else, where their work is supervised, but seemingly, they do not want to farm for themselves” (Gerharz 1946, 19-29). He reported of all reservation lands:

Of the available irrigable acreage, 5,194 acres are farmed by Indians; 8,164 acres of Indian land by non-Indian lessees; and 9,573 acres by non-Indian owners... The balance of the irrigable area consisting of 32,692 acres in Indian ownership and 7,143 in non-Indian ownership is idle for various reasons, the principal reason being lack of capital to carry on farming operations, distaste for farming by the owner, availability of wage work, heirship ownership by the Indian owner, lack of capital to subjugate the land, weed infestation, poor drainage and accumulation of past due O & M charges (19-20).

Additional problems plagued Indian farming as they had for years. In a correspondence describing farming problems, (1945) Gerharz writes:
Under present conditions, Indian farmers living on their land during the Summer, obtain their water supply from the Irrigation ditches. In the Fall many of them move down to the River where wood and water are handy. They crowd into tents or small shacks and their living conditions are very unsanitary, with a consequent increase in sickness. Moving away from their farms every Fall, they do not own or keep milk cows, chickens or pigs, and it is practically impossible to make a farm pay without these animals. Surface water wells, with water suitable for animals can be dug cheaply practically everywhere in the irrigated area, but as these waters are impregnated with mineral salts they are not suitable for human consumption. Drilled wells for domestic water supply are not economically feasible because of the great cost…The simplest solution for this and other problems connected with living conditions would be to have these people live in small communities…

Between 1944 and 1954, 33 miles of sub-laterals were constructed on the Wind River Project, and irrigated acreage increased by 14,000 acres to create 36,000 irrigable acres of land. During the same time period, irrigation by Indians increased only 2,500 acres to a total of 7,500 acres. Indians irrigated one third and leased two thirds of irrigated lands (Missouri River Basin Field Committee 1954b, 41).

The heirship problem was blamed for the lack of Indian irrigation (Missouri River Basin Field Committee 1954b, 41) but a 1957 redesignation report of irrigable lands reads as if it were written for the Third Division of the Riverton Project. In addition to the heirship problem, lands were not utilized because they were poorly drained and saline, infested with noxious weeds, rough and uneven, and undeveloped “virgin lands” that needed clearing (Redesignation Committee 1957, 19a). The committee noted that farmers “have experienced reduced crop returns and, in some cases, complete crop failure on some of these land types.”
The “problem soils” required special management. Again, similar to the Bureau of Reclamation response to problems on the Third Division, Douglas suggested changes to solve the heirship dilemma, and then blamed the Indians’ lack of education, and the lack of intelligible information available to Indians, for their little desire to farm. He suggested the distribution of pamphlets explaining the fundamentals of soils, soil-plant-water relationships, and information about improved irrigation farming methods would help remedy this problem and motivate Indians to farm marginal lands (Redesignation Committee 1957, 20b-21a).

It would be hard to disagree with Superintendent Stone, who in a 1942 letter to the Commissioner of Indian Affairs wrote “…it is not surprising that the Indian has become soured on farming, and is anxious to lease his land, and to get into something which will supply him with a wage…” (Stone 1942). By 1964, Indians were still not using the amount of irrigated land they had prior to 1906, when they watered land from private ditches (Wilson 1973, 297).

A Dynamic Environment

During the era of 1939-1975, it became clear that the environment was not a blank slate to be rearranged and improved according to plan. It was a dynamic and co-creative force, full of unanticipated surprises. Fiege (2005) astutely calls the irrigation landscape of Idaho a “hybrid” landscape formed from the adapting, dynamic relationship between people and environment, but the Wind River Basin and its complex cultural landscape deserves at least the plural hybrid
landscapes. Change was rarely received on a united front. The varied cultural backgrounds of the basin, in addition to a complex land ownership mosaic, resulted in a variety of responses and ways of co-adapting with environmental and political change.

**Alteration of Flows:** By 1940, the major irrigation infrastructure had been completed and by 1980 it irrigated over 100,000 acres of land. Two major reservoirs, Dinwoody and Bull Lake (completed in 1935 and 1938, respectively), collected water from the high country and released it during irrigation season. The vast majority of this water irrigated 72,929 acres of the Riverton Project with water diverted by Diversion Dam, funneled through the Wyoming Canal to Pilot Butte Reservoir, and then distributed to Project lands (Autobee 1996). The BIA’s Wind River Irrigation Project pulled water from the Wind River and irrigated 18,215 additional acres of land on the Lefthand, Johnstown, Upper Wind and LeClair-Riverton Units (Bureau of Indian Affairs 1968a, 20). Flows dropped dramatically, running at just over half their pre-diversion levels (Figure 2.31).

The environmental consequences of these decreased flows were rarely discussed earlier in the century, but appeared with increasing frequency after World War II (Wyoming Reclamation Projects Survey Team 1963, 27) particularly with respect to their impact on tourism. Basin plans still prioritized agriculture in the lowlands, but the high country was touted as an important home for fish and wildlife, where “plans for water development should not ignore the problems
created by impounding waters and altering the natural regimens of streams”
(Missouri River Basin Field Committee 1952, 84).

Tourist promoters boasted, “Nowhere is there a more apt setting for stories about the ‘big one that got away’ or ‘the size of that head’” and:

The Wind River high country is the land of the hunter and fisherman. Its streams and forests combine to form a sportsman’s paradise. The clear cold waters of mountain streams and lakes abound with trout. Moose graze the high protected meadows and bears share the wilderness with bighorn sheep. These animals inhabit a beautiful, primitive terrain (Missouri River Basin Field Committee 1952, 24).

More pointedly, this beautiful terrain brought revenue. “There are trout streams in Wyoming where fishermen are spending $10,000 per mile per season” (Missouri River Basin Field Committee 1954b, 72). Admittedly, Wind
River Basin streams were not worth that much, but “the day of comparable utilization in the basin may not be distant.” A 1950s study suggested that revenues from Wind River Basin restaurants and service stations, indicative of tourist spending, were 52 percent higher than the state average. Concern for fisheries led to the establishment of minimum flow requirements for Bull Lake Creek, below Bull Lake Dam in 1952, (Bureau of Reclamation 1952, 48) and the deleterious effects of irrigation on trout were noted (Missouri River Basin Field Committee 1952, 25-26). Depleted flows and sudden changes in flow; silt-laden waste waters; and the passage of fish into drainage canals decreased fish populations. In addition “rough fish” (carp, suckers, chubs) competed with natives. Yet, paradoxically, some irrigation structures had the opposite effect, “By accident rather than design…” Ocean Lake supported a phenomenal population of black crappies and wastewater pools and lakes drew in waterfowl (Wyoming Reclamation Projects Survey Team 1963, 27). As tourism was recognized as a strong contributor to the local economy, plans increasingly discussed the incorporation of fish and wildlife conservation on the Riverton Project (Wyoming Reclamation Projects Survey Team 1963, 27) and tribes took the discussion one step further.

In 1975, the tribes decided to use their priority water rights to maintain a flow in the Wind River that was substantial enough to support trout and a tourism industry (Autobee 1996). Wildlife conservation was a shared concern, but when weighed in the worth of water, that concern split on cultural/political lines that would accumulate into larger and more contentious differences.
Vegetation: Vegetation is perhaps not as obviously shared as water; but also cannot be as easily owned as land. Somewhere in between, and categorized as "mobile nature" by Fiege, it sometimes stays in one place, and sometimes widely and aggressively propagates itself paying no mind to fences.

The vegetation landscape of the basin was dramatically altered during the 20th Century. Uplands that had been dotted with sage were planted with alfalfa; riparian areas were full of introduced trees (e.g. Russian olive) and weeds (e.g. Canada thistle). This landscape continued to evolve as farmers tried to optimize crops and eradicate weeds; stock growers shifted from sheep to cattle and went after pests; and tribal members harvested berries and plants, but in different ways than they had in the past. Everyone in the basin shared a riparian landscape in the midst of dramatic change.

Relationships with vegetation were co-adapting with the introduction of new species and new lifestyles. Weeds were a constant aggravation, more complicated because they moved across political boundaries and forced efforts to control them to do the same. As Mark Fiege emphasizes, weeds provide an example of “the incompatibility of human boundaries and forms of mobile nature” (24). They “open a landscape defined less by linear divisions than by the shared experience of ecological connections.” Plants, and particularly weeds, are opportunistic propagators that move in a world of ecological, not human limits.

As people became more mobile, weeds spread over oceans and across continents. Halogeton, a native of Asia that has now invaded millions of acres in
the West, allegedly entered the basin along the Chicago, Burlington and Quincy Railroad right-of-way (Missouri River Basin Field Committee 1954b, 32). Locals near Crowheart refer to Russian knapweed as “Crow Creek alfalfa” that arrived in a bag of oats. It moved down out of Crow Creek, a tributary to the Wind River, and “people bought the oats and it was everywhere” (Urbigkiet personal communication 2010). When discussing expansion of the Riverton Project, a Bureau of Reclamation report warns “Past experience has shown that weeds spread rapidly into new areas after they are opened to settlement” (Bureau of Reclamation 1952).

The Wind River 1942 extension report says “situation becoming critical” and in 1944 the reservation superintendent Stone writes, “We have a very serious noxious weed problem on this reservation (Figure 2.32). To illustrate how aggressive these weeds are and how rapidly they spread, it might be stated that we have had surveys made of the weed situation on the irrigated land for the last four years. These surveys identified 500 acres of noxious weeds in 1939; 800 acres in 1940; 1,600 acres in 1941 and 2,130 acres in 1942. Such an increase in weed infested acreage is alarming” (Stone 1944, 9-10).
Stone explains that their agency received a $10,000 appropriation for weed control in 1941 and again in 1942:

While we have purchased equipment to carry on this work, we have not been able to agree on a plan of procedure as to how the money to be expended is to be distributed in the cost, primarily because of legal restrictions. This phase of the problem has been the subject of much correspondence and many conferences but no satisfactory solution has been found and no actual weed control work on the farm lands has been done (1944, 10).

The problem was twofold: 1) land was so checker-boarded between private (or fee land) and tribal lands, that it failed to meet criteria for the state pest law and 2) federal lands were exempt from taxation, which funded the weed and pest programs. Stone suggested that the remedy for this problem was to ask Congress to pass a special law that authorized reservations to be declared weed control districts. Costs would be divided equally between tribal funds, reimbursable funds advanced from Congress to land owners, and the rest collected with operation and maintenance irrigation charges.
Soils: Soils are not “mobile nature” in the same sense as water or weeds, but, like climate, they are a shared environmental element of particular importance in agricultural communities and were increasingly problematic as lands were converted to agriculture. Expectations of soil capabilities proved optimistic. The 1907 Wyoming Central Irrigation Company advertising brochure boasted of project lands:

The soil is a very rich sandy loam, often forty feet in depth, and has proven here, as well as in other sections of the State, to be very productive...The average yield of the arid lands in the Rockies of the different kinds of crops is from 40 per cent to 75 per cent greater every year than that of the humid portions of the United States... besides, there is no failure of crops under irrigation (4-6).

Shortly after planting, major soil problems developed on the Riverton Project as well as on Indian lands; the Shoshone Irrigation Project (later the Wind River Irrigation Project) reported difficulties with erosion as early as 1913 (Indian Service 1913, 2). Problems compounded. Poor drainage led to high water table and excess salts; draining loose soils led to massive amounts of erosion. At the root of the problem was the soil itself.

Geologically, the Wind River Basin is mainly composed of sedimentary rocks that bend with the uplift of the Owl Creek and Wind River Mountains so that the oldest rock is found nearest the uplift. Limestones, quartzite and dolomites are found at higher elevations; shales, siltstones, and scattered sandstone occur at lower elevations (Missouri River Basin Investigations Staff 1950). A 1963 report analyzed the relationships between geology and soils, “In general,
experience has shown that irrigation projects built on soils overlying sandstone and shale barriers invariably lead to problems associated with drainage, water management, and accumulation of excess salts” (Wyoming Reclamation Projects Survey Team 1963, 46). Essentially, irrigation water cannot permeate these layers. An upward movement of salts occurs in saturated soils and as water evaporates and salts accumulate on the surface. Excess salts inhibit crop growth.

Over-watering exacerbated the problem on both the Wind River and Riverton Irrigation Projects. When a survey team calculated the amount of water farmers reported they diverted from the ditch in 1953, it appeared that they actually covered their fields with a flow of water 24 inches deep over a 12 hour period, three to five times more than necessary (Wyoming Reclamation Projects Survey Team 1963, 53). On the Wind River project, “In fact, the cost of preparing the land so that it can be efficiently irrigated with a small amount of water is quite high, so that most irrigators use large quantities to force the water over high spots in their fields” (Gerharz 1946, 24).

To inhibit water logging, and thus accumulation of salts, the projects installed drains and lined canals to prevent seepage. By 1963 the Midvale Irrigation District of the Riverton Project spent almost four million dollars on drains, canal linings, and farm laterals which only covered 20%, or 9000 acres (Wyoming Reclamation Projects Survey Team 1963, 3). But even areas that had been protected were damaged when livestock walked through canals. When liners were installed, willows clogged drains (50, 57). Irrigators complained that
many of the drains, in both irrigation projects, were not effective, and that five to ten years or more were required to reclaim the lands (187). A committee assigned to analyze the Wind River Irrigation Project wrote in its report:

> It is regrettable that Trout Creek ‘D’ was ever constructed, resulting only in loss of land to the owner, expenditure of wateruser’s funds, and time wasted by project personnel; still the land is wet. If previous investigations had been made, this drain would probably never have been constructed (Redesignation Committee 1957, 16).

Similarly, a survey team for the Riverton Project wrote:

> On the basis of previous evidence presented, one must conclude that some mistakes have been made in the installation of certain drains, that the effectiveness of some drains has been impaired by position and that drainage in some cases came “too little and too late” (Wyoming Reclamation Projects Survey Team 1963, 117).

In places, the problem was not water pooling, it was soil eroding as a result of water flow in loose soils. While erosion was first mentioned in irrigation reports on the reservation in 1914, the problem grew with increased irrigation. Stone (49), of reservation lands, writes, “It is found that in many cases the current during spring floods and cloud burst periods is cutting in to valuable farm land and range which, if not checked, will destroy in many cases land valued at as much or more than the entire $12,000 requested on this project.” Weather events were not nearly as responsible as irrigation runoff pouring through areas not accustomed to steady flow. Overgrazing and development also played a role.

A 1947 land classification of Boysen (Bureau of Land Management 1947) suggests that excess siltation in the river was a result of sixty years worth of deterioration, and in some cases “outright destruction,” of native vegetation.
Valuable overgrazed grasses were being replaced by “economically inferior or worthless grasses, half shrubs, and annual weeds…” and encouraged swift run-off and excess silting during storm events. Less serious problems were found in areas with small proportions of cultivated land, or land that had never been cultivated and still maintained protective wind resistant surfaces (15). More serious problems were found in overgrazed lands, and trails and roads certainly played a role:

This is especially true of trails constructed on a straight line grid, without regard for the natural lay of the land. These are numerous and in some localities as the result of recent oil investigations and developments. Erosion has set in on most of these, and they present a continued threat in this respect (Missouri River Basin Investigations Staff 1950, 13).

Figure 2.33 Bank stabilization using limbs of trees. Photo courtesy of the Bureau of Indian Affairs, Ft. Washakie.

The most serious erosion problems were located in the lower basin: Muddy, Badwater, Muskrat and Beaver Creeks (Figure 2.33); but by far the most severe was found in Fivemile Creek, which drained the Riverton Project (Missouri
River Basin Investigations Staff 1950, 7). In 1948-1949 the erosion became so extreme that 45 percent of the Wind River’s sediment load originated in Fivemile drainage, which increased to 70 percent by 1949-1950; 87 percent of the sediment discharge of Fivemile Creek was derived from the stream channel within the Riverton Project during irrigation season (Missouri River Basin Field Committee 1954b, 76).

When the Missouri Valley Investigations began planning a massive reservoir downstream, the erosion problem became a paramount concern. “Physiographic deterioration of the basin’s drainage system contributes to the excessive silting of Bighorn River which carries the heaviest silt load of any major tributary of the Missouri River system” (Bureau of Land Management 1947, IV). Unless sediment was controlled, the dam would rapidly fill. The first Boysen Reservoir, built in 1910 at the mouth of the canyon, was nearly full of silt by 1923 (7). Plans were made for better drainage construction and more rigid design criteria and measures were taken to slow the erosion on Fivemile (Bureau of Reclamation 1952, 36).

A 1954 progress report for the Missouri River Basin Plan reports that 296,000 woody plantings were made to stabilize the banks:

Grass, legumes, trees, and bushes were planted along the Fivemile Creek where silt deposits had been built up behind established structures and where soil and moisture conditions were satisfactory. These will provide the necessary bank protection after the structural works have disintegrated. Between 50,000 and 60,000 golden willow, Russian olive, water willow, cottonwoods, and other adapted trees or bushes will be planted each spring (Missouri River Basin Field Committee 1954b, 97).
Vegetation plantings took place elsewhere as well, in addition to other innovative forms of control (Figure 2.34), but appear to have achieved mixed results. Tree plantings were found to be successful in areas where grazing was limited, but were unsuccessful in grazed areas (Missouri River Basin Field Committee 1954b, 91). Other areas were completely unsuccessful (84).

The land classification report for the Boysen area insightfully notes that “Erosion on such a scale is symptomatic of disrupted natural harmonies which, if unattended, threaten to cause even more serious and widespread land breakdown” (Bureau of Land Management 1947, IV-V,7).

Figure 2.34 Cars are used to stabilize banks on the Wind River. Photo taken by Bodura and Lofgren Dec. 19, 1973. Photo courtesy of the BIA, Ft. Washakie.

In efforts to stabilize the erosion, new problems were introduced. Though these plantings were certainly not entirely responsible for the spread of Russian olive or tamarisk in the basin, we can assume they played a role. Fremont County Weed and Pest believes tamarisk may have been purposefully
established as erosion control near Boysen Dam (Baker personal communication 2009), and Russian olive certainly was. Both are now considered noxious weeds in Fremont County (Figure 2.35). Again, mobile nature trumped human attempts to control it; the basin welcomed Russian olive and tamarisk as permanent additions to its flora.

Figure 2.35 Golden willow and Russian olive plantings, 1953. Photos courtesy of the Bureau of Indian Affairs at Ft. Washakie.
The era of 1939-1975 joined the basin together. Its residents shared the transformation of the Basin as a whole. They joined together to fight weeds and pests. They struggled together against accumulating salts in soils. And their livestock, crops, and extractive industries fluctuated with influences of the same market trends. But the Basin joined together in additional ways during this era. Federal policies of the Reorganization Act era reversed previous practices that divided the basin earlier in the century. The size of the reservation doubled. Tribally and non-tribally owned lands checker-boarded both sides of the Wind River, whose water they shared.

With the help of Shoshone Judgment Fund capital and additional government funds, tribes were much more involved in the developing capitalist economy. They participated in the livestock industry, leased lands, and prospered in oil and gas extraction. They exercised much more control over their lands. With the exception of the government taking involving Boysen Dam lands, boundaries were stable; the tribes maintained and managed reservation lands through their own system of governance. The tribes’ new financial prosperity, and ability to exercise power, brought the whole basin into a new era.
``The Big Horns of a Dilemma”: 1977-2010

Figure 2.36 Land use along the Wind River. In many places, the Wind River serves as a land ownership boundary and demarcates different land use. In this image, use of the Wind River floodplain is markedly different on the east and west sides of the river at the juncture of the Wind River and Muskrat Creek (NAIP imagery, 2006).

Boundaries and Legal Control

As the tribes gained financial backing and power dynamics shifted, and as and the discrepancy in government investment in irrigation became more blatant, the governance of the river took a new legal turn in 1977. When Teno Roncalio, appointed special master of the court cases to come, reflected on his role, he titled his chapter in Indian Water in the New West the “Big Horns of a Dilemma” (1993). Indeed they were. In January of 1977 the state of Wyoming filed suit against the tribes of the Wind River Reservation; officially, differences in
ideologies were beyond the ability of local mediation to reconcile. The tribes and State Water Engineer were at odds over who controlled water in the Wind River. What followed have been decades of law suits between the Wind River Tribes, the State, and irrigators along the river, leaving all parties in a somewhat similar position to where they were when the judicial process began (Dillon 1998, 1-4). Underlying the years of rulings and appeals may lurk a common, understated Western concern: “There is widespread fear that Indians will become the water brokers of the West, extracting rents for their unused entitlements from those now using that water” (McGuire 1993, 3). In opposition stands a second fear: the tribes worry that they will lose more than they already have.

The court cases have been part of the “Big Horn Adjudication” the name the Wind River receives, ironically, after it flows off the reservation and through the Wind River Canyon. The adjudication began in 1977, reaching its climax in 1992. While a number of cases involve three different phases of the Big Horn adjudication, this discussion focuses on Big Horn I and Big Horn III, which were high profile cases, critical to Indian and non-Indian water rights in the Wind River and nationally. These cases set important precedents for tribes and influenced the legal landscape of tribal waters.

Six years after the Big Horn I lawsuit was filed by the state of Wyoming, District Judge Joffe affirmed a federal reserved water right of over 500,000 acre-feet to the Wind River tribes. This water right was based on (1) the Winters Doctrine and federal reserve water rights (2) the “primary purpose” test, and (3)
the Practicably Irrigable Acreage precedent (Roncalio 1993, 209-214). These require at least a brief overview.

The details of the Big Horn cases are complex but involve key elements of Indian water law. The first is the establishment of federal reserve water rights, guaranteed by the Winters Doctrine and Arizona v. California, which reserves water rights held by the federal government, directly or in trust for tribes. In Cappeart v United States (1976) the Supreme Court ruled further that federal reserve water rights are guaranteed on the grounds that water serves the need for which the federal reserve was established. No more water is allowed than what is required for that designated purpose (Coggins, Wilkinson, and Leshy 2001). The second is the “primary purpose” test, which assesses the designated purpose of a reservation, and designates water rights based on that purpose (Martinis 1993). Once that primary purpose is designated, the “Practicably Irrigable Acreage (PIA)” assessment became a means of quantifying water rights for tribes, established in Arizona v. California (Coggins, Wilkinson, and Leshy 2001). PIA quantifies tribal water by calculating the amount of acreage on the reservations that can be practicably irrigated, even if it is not currently developed for agriculture (Mergen and Liu 1997). PIA is now a standard for quantifying federal reserve (including Indian) water rights (Martinis 1993). The third important element of Indian Water law is the McCarran Amendment, which Congress passed in 1952, which allows the United States to be joined as a defendant in state court adjudications of all the water rights in a stream system.
This means the extent of federal rights relative to other water users can be determined in state courts (Getches 1993, 15), including Indian water rights.

**Big Horn I:** During the Big Horn I court case, when the Wind River federal reserve water rights were established but not quantified, Teno Roncalio was hired as a special master to determine the scope of the tribal water right. Roncalio awarded tribal water for irrigation, stock watering, fisheries, wildlife, aesthetics, mineral, industrial, domestic, commercial, and municipal uses based on the federal government’s intent to create the reservation as a permanent homeland for the Shoshone and Arapaho tribes (Dillon 1998, 39), under the primary purpose test (Roncalio 1993, 211-213). Judge Jaffe disagreed with Roncalio on one important point; he believed that the government merely established the reservation “to convert the Indians from a nomadic to an agrarian people” and decreased the water right by 20,000 acre feet (Dillon 1998, 39; Mergen and Liu 1997). Thus, the half a million acre-feet water right was based on practicably irrigable acreage quantified by the amount of reservation land with agricultural potential. Jaffe confined the tribes’ water use to the reservation, but noted that it could be used at the discretion of the tribes (Mergen and Liu 1997).

All parties appealed to the Wyoming Supreme Court which affirmed the decision on February 24, 1988 (Dillon 1998, 40). The court interpreted the Second Treaty of Fort Bridger as designating the reservation for the sole purpose of agriculture (Regents of the University of California 1994) and quantified the water right based on agricultural, livestock, municipal, domestic, and commercial
water uses (Dillon 1998, 40). Other uses were not considered. An award for future water, or water that was allotted even though it was not yet used, was established based on lands undeveloped for irrigation (41).

All parties appealed to the United States Supreme Court. The State of Wyoming questioned whether a water right existed for the tribes, if PIA was the proper method of quantification and if the priority date on the 1904 ceded land that was returned to the tribes in 1939 should hold an 1868 priority date, or the later dates designated by the Doctrine of Prior Appropriations (41-42). The State called the water rights settlement, an “unjustified windfall” to the tribes (Mergen and Liu 1997). The tribes, on the other hand, objected to the designated primary purpose. They argued that their reservation was designated as a “permanent homeland” and not as an “agricultural homeland.” They also objected to the designation of an 1868 priority date to non-Indian lands within reservation boundaries. In addition, they questioned the their groundwater right, the ability to export water from the reservation and the establishment of reserve water rights on historic reservation lands (Dillon 1998, 42). They objected to quantification based on minimum need (as is the standard for federal reserve water rights) pointing out that “this case involves… two Indian tribes, not the water reserved for a federal reservation to protect pupfish or trees” (Mergen and Liu 1997).

The US Supreme Court decided only to review the PIA methodology, and on July 3, 1989 upheld the Wyoming State Supreme Court decision; a water right of 500,000 acre feet of water was awarded to the Wind River Tribes, which held an 1868 priority date, and 210,000 additional acre-feet of water were awarded for
future development (Dillon 1998, 42). Considering that the Yellowstone River Compact allocates 80 percent, or 3.12 million acre-feet of the Big Horn River’s average annual flow of 3.9 million to Wyoming, this water right is substantial; it comprises over 20 percent of Wyoming’s Big Horn allocation (Bellamore 2002, 19).

Special master Teno Roncalio noted years later, “This contest produced… a transcript of over 15,000 pages, over 2,300 exhibits admitted into evidence, and a 450-page report…many Wyoming lawmakers and officials regretted the day the lawsuit was filed” (Roncalio 1993, 211).

The paperwork was certainly not over.

**Big Horn III:** On April 12, 1990, the tribes granted themselves an instream flow permit, thereby dedicating a portion of their futures water right (awarded in Bighorn I) to maintaining fisheries in the Wind River. After establishing a tribal Water Code and a Water Resources Control Board, the tribes dedicated up to 252 cfs to fisheries enhancement, recreation, groundwater recharge, and other benefits to water users (835 P.2d 273 1992). The following spring, flow levels fell below the standards the tribes had set and the tribes complained to the state engineer. The state engineer responded that “their permit was unenforceable” since the reserved water right only applied to diverted water (835 P.2d 273 1992). The tribes brought suit in the Wyoming State Court (Martinis 1993) just a year after Big Horn I was settled.
On March 11, 1991 Judge Hartman ruled that the Tribes were allowed to (1) use their water rights for instream flow, and for other purposes they decided (2) the tribes would administer state water instead of the State Engineer (Dillon 1998; 835 P.2d 273 1992; Martinis 1993). They maintained that agricultural purposes were assessed in order to quantify, but not limit uses, of their water (835 P.2d 273 1992). Upon appeal, the Wyoming Supreme Court voted three to two to reverse Judge Hartman’s 1991 ruling. Judge Macy stated:

Our opinion clearly and unequivocally stated [in Big Horn I] that the Tribes had the right to use a quantified amount of water on their reservation solely for agricultural and subsumed purposes and not for instream purposes… Big Horn I, having been affirmed by the United States Supreme Court, is final and controlling. The Tribes do not have the unfettered right to use their quantified amount of future project water for any purpose they desire…It makes no sense whatsoever for this court to limit the use of the water for agricultural purposes and to permit the Tribes to unilaterally change that use (835 P.2d 273 1992).

The court emphasized that instream flows are monitored by the state. “Water is the lifeblood of Wyoming. It is a scarce resource which must be effectively managed and efficiently used to meet the various demands of society. Wyoming’s founding fathers also recognized the necessity of having state control over this vital resource.” Correspondingly, the court ruled that the State Engineer would continue to regulate water, not tribes, “The district court’s action violated not only the separation of powers doctrine embodied in the Wyoming Constitution, but also the constitutional charge that the state engineer shall have ‘general supervision of the waters of the state’” (835 P.2d 273 1992). Thus, the
Wyoming Supreme Court granted power over water use in the Wind River to the state over the tribes. The tribes did not appeal.

**Dissents:** Many law journals have written about the Big Horn lawsuits, since they set an important Federal Supreme Court precedent for tribes. Additionally, many tribes now use the Wind River example as what *not* to do (Crocker personal communication 2010).

One of the most compelling articles written after the lawsuits appeared in the Colorado Law Review (Mergen and Liu 1997). This article discusses the *unpublished* draft opinions of the U.S. Supreme Court, found in the files of the late Justice Thurgood Marshall. Before the U.S. Supreme Court decision was issued in 1989, Justice Sandra Day O’Connor discovered that her family’s ranching corporation was involved in a stream adjudication involving Indian water rights, and disqualified herself from the case. However, she had already written a draft opinion, which would have dramatically changed the court decision. Before she removed herself, the court was poised to deliver an opinion that would have qualified the PIA standard with a “sensitivity” analysis. According to this analysis, federal reserve water settlements would have to issue rights based on (1) the economic feasibility of the project (2) display sensitivity to the impact on state and private appropriators and (3) and tailor rights to minimum need (Mergen and Liu 1997). The “sensitivity” analysis would have weakened Indian water rights considerably.
Justice Brennan’s “vigorous twenty-three page draft dissent” was also revealed in the Marshall Papers. Justice Brennan objects to the phrase “unjustified windfall to the tribes” that O’Connor again uses. He writes:

Between 1907 and 1987, the United States allocated a total of $4.4 million toward construction and maintenance of Indian irrigation projects on the reservation; these projects irrigated 54,000 acres of land. However, the United States subsidized non-Indian irrigation development on the reservation to an even greater extent. Non-Indian irrigation projects benefit approximately 120,000 acres within the reservation, including approximately 73,000 acres served by the federally funded Riverton Reclamation Project, which lies entirely within the ceded portion of the reservation. In contrast to the $4.4 million in Indian water project funding, the United States spent more than $70 million on the Riverton Reclamation Project alone. This dramatic difference in historical support for Indian and non-Indian water projects highlights the insensitivity of an analysis that would further erode the existing rights of Indian tribes (Mergen and Liu 1997).

His statements are useful in considering what almost happened, not what happened. When Justice O’Connor stepped down from the case, the court was divided evenly, and the PIA standard upheld.

Many people questioned why the tribes did not appeal, though it is clear that Indian water was in a precarious position. Other tribes, in fact, encouraged the Wind River tribes not to appeal, for fear that all tribes would suffer (Dillon 1998, 47).

The Wyoming State Supreme Court published a similar dissent that reveals strong undercurrents attacking the very morality of the Wyoming Supreme Court. Justice Golden concludes his extensive dissent with:

Today some members of the court sound a warning to the Tribes that they are determined to complete the agenda initiated
over one hundred years ago and are willing to pervert prior decisions to advance that aim. I cannot be a party to deliberate and transparent efforts to eliminate the political and economic base of the Indian peoples under the distorted guise of state water law superiority (835 P.2d 273 1992).

Berrie Martinis, in the Washington Law Review (1993) argues that “the Wyoming decision contradicts federal reserved water rights law and federal Indian law, and concludes that Congress should enact legislation overturning the Big Horn III decision.” The University of California Davis law review (1994) concludes:

In Big Horn III, the Wyoming Supreme Court unjustifiably denied the Wind River Tribes the right to convert their future water rights to present instream flows. The court should have looked to the controlling federal precedent allowing Indian tribes to change the use of their water from one beneficial use to another.

**Ongoing Litigation:** After millions of dollars in legal fees, and years of litigation, the region is still not content. The Casper Tribune, on March 11, 2004 reports:

Charlene Delaunay, an enrolled member of the Northern Arapaho tribe, and her husband, a Caucasian native of France, filed suit against Tribal Water Engineer ...The Delaunays contended their civil rights had been violated through the intentional blocking of their water supply and physical attacks on them because of Manuel Delaunay’s race.

A different 2010 case disputes whether the boundary of the reservation should include Riverton with lands returned in 1939. Amidst these smaller court cases loom the larger concerns: tribes hold a substantial water right of half a million acre feet with priority over the Riverton Project. Should the tribes have the funding and interest in diverting water from the Wind River onto tribal lands, they
may take that water and leave the irrigation project dry. The paper right swings power to the tribes, a dramatic switch from the direction power has flowed during the 20th Century.

Population and Settlement Patterns

Fremont County’s population was reported as 35,804 in Census 2000. The reservation population was 23,250 (on reservation and off reservation trust land), 6,864 of whom were American Indian (U.S. Census Bureau 2004-2005), and 9,310 of whom lived in Riverton (U.S. Census Bureau 2000a). Many areas remain culturally distinct. Ft. Washakie, Ethete, and Arapahoe, for example, remain centers of population on tribal lands, with 1477, 1455, and 1766 inhabitants, respectively, of whom 80 percent reported American Indian race. Shoshoni, just off the reservation, is home to 635 people, only 1.3 percent of whom report American Indian race. Only 8.1 percent of Riverton’s population reports Native American race. In contrast, other areas are more diverse; just over 43 percent of Crowheart’s 163 people, for example, report American Indian race. Fewer Shoshones and Arapahos inhabit lands north of the river, most likely because of early settlement history combined with the 30 years in which the tribes no longer owned these lands.

Despite cultural differences, basin residents shared, and argued over, many aspects of the basin in the 20th Century: the river, vegetation, soils. They fought weeds, pests (some that they had introduced, either on purpose or by accident) and salty and eroding soils. The environment and its human inhabitants
were endlessly creative and adaptive to change. But ownership mosaics and very different cultural histories led to the development of different human-environmental relationships, or what Fiege calls “hybrid human ecology” that shaped the landscape differently.

The following sets of images depict the development of different human-environmental relationships over time, on a communal level, and on a larger Basin-wide scale. The first set of images (Figure 2.37 a-c) is a mosaic of 1948 aerial images in which basic irrigation infrastructure on the north side of the river near Riverton has been established and agricultural lands developed; the second is 2006 NAIP imagery from the same area showing the northern irrigation infrastructure supporting agricultural lands, suburban homes and a golf course; and the third is a transparent ownership overlay in which red is alienated fee land; yellow is allotted land; and brown tribal land. In this particular area brown and yellow lands are generally tribally owned and the river divides reservation from non-reservation lands. It is interesting to note that drainage canals do crisscross the landscape on the south side of the river, but agricultural lands have not been developed, and the area is either idle or used for grazing.

The transition from agricultural lands to urban lands (Figure 2.37 a and b) in recent years is not uncommon in the New West (Travis 2007, 71-73, and others). A golf course replacing a field of alfalfa or rangeland is somewhat typical. The disproportionate amount of development on the north and south sides of the river over a 60-year period is notable, and undoubtedly linked to several complex historical factors. First, as Wilson (1973) exemplifies repeatedly, tribes have
historically preferred ranching to farming for a number of reasons relating to both cultural preferences and economic disparities. Though the number of cattle owned by tribal members has decreased since his analysis, the trend still holds. Within the exterior reservation boundaries (which include the irrigation project), tribal lands are far less likely to be cultivated than non-tribal lands, particularly in row crops. Second, idle lands are often related to heirship problems but may also relate to cultural preferences and settlement patterns. Third, urbanization is not a reservation trend. Development patterns are intrinsically different on reservation lands than on non-reservation lands.

Figure 2.37 Changes in land use between 1948 and 2006: a) 1948 aerial photo of tribal lands on the south side of the river, alienated lands on the north, b) 2006 NAIP imagery depicting a golf course amidst agricultural lands in the north and undeveloped lands to the south, c) area superimposed with a BIA land ownership layer, red representing fee land, yellow allotted land and brown tribal land.
A second set of images (Figure 2.38) further illustrates this point. They depict four basin communities, Shoshoni, Riverton, Ft. Washakie, and Arapahoe. The two towns on the north side of the river, Riverton and Shoshoni, have grown from their original settlement patterns, which were 160-acre parcels of land divided into individual lots. Their settlement pattern reflects a land use pattern of subdivision in which small, regular parcels are individually owned.

Figure 2.38 Four settlement mosaics in the Wind River Basin. Images depict four communities and their different settlement patterns, NAIP imagery.
Conversely, Arapahoe and Ft. Washakie are community centers for Eastern Shoshone and Northern Arapaho people, respectively. Ft. Washakie evolved from its militia site in 1871 to the government center for the Eastern Shoshone Tribe (Stamm 1999, 106). Arapahoe evolved from the original establishment of the Northern Arapaho people on the southern end of the Shoshone Reservation. Their communities grew from these locations in dispersed ways. Shoshone and Arapaho housing is much less subdivided and geometric than non-Native towns north of the river, except in government housing communities. Housing is often constructed in family units, where several houses with extended family members live on family land.

A third set of images (Figure 2.39 a and b) zooms out to cover a larger area, where broader vegetative patterns, and their relationship to political boundaries, are visible.

Figure 2.39 Reservation boundaries and vegetative patterns, 2006. NAIP imagery a) without a reservation land layer and b) with a reservation land layer.
The image to the left without the reservation boundary shows ribbons of vegetation lining water routes along the Basin’s rivers and diversions. The image to the right shows the reservation boundary, with the most well developed agricultural lands visible in the Riverton Irrigation withdrawal lands.

A final map (Figure 2.40) shows the truly complicated mosaic of tribal lands (brown), allotted lands (yellow), fee lands (orange), and Riverton Irrigation withdrawal lands (white). These heterogeneous ownership patterns developed from remarkable relationships, the evolution of resource based capitalism, the enduring influence of tribal communalism, government interests, different cultural values, and geographies of power.

Figure 2.40 Map depicts the complex ownership patterns of the Wind River Basin. Yellow lands represent allotted land, brown lands tribal lands, orange lands fee land, and white lands the Riverton Irrigation withdrawal.
Many maps of the State of Wyoming depict the reservation as one solid block of land. Several others demarcate a “hole” in the central eastern portion of the reservation, and very few detail the complicated ownership patterns of the reservation that include fee land, allotted land, the Riverton Project irrigation withdrawal, state and federal lands. While, arguably, many state maps simplify to make maps intelligible, power dynamics are evident in the ways lines are drawn. Patricia Limerick (1987) writes, “Western history is a story structured by the drawing of lines and the marking of borders” and the history we tell ourselves is often over simplified and mythologized, particularly in the cowboy and Indian West. The nuances of reservation boundaries, and its internal lines, are critical to the environmental history of this region.

Land and Water Use


Agriculture, forestry, fishing and hunting comprise 1.3% of Wyoming’s Gross Domestic Product. Although agriculture does not make up a large portion of Wyoming’s GDP, it contributes considerably to the culture and lifestyle of Wyoming’s residents. Wyoming has a rich agricultural history and many rural residents rely on agriculture for their livelihood. The influence and significance of agriculture may not be evident in a basic analysis of Wyoming’s economy, but visiting the State or talking with one of the many ranching or farming families reveals the importance of agriculture to Wyoming’s identity (State of Wyoming 2009, 9)
In addition to its role in Wyoming’s place identity, agriculture spans an enormous amount of land in the state and is the largest consumptive water user, accounting for 80 to 85 percent of consumptive water use in the state (Jacobs and Brosz 2000). It is a considerable factor of land and water use, if not income.

Fremont County plays a strong role in state agriculture. It currently has 1,394 farms spanning 1,800,538 acres, making it the county with the greatest number of farms in the state (U.S. Department of Agriculture 2007a; State of Wyoming 2009). Croplands account for just 9.45 percent of those lands, pasture 87.96 percent, and other uses 2.59 percent (U.S. Department of Agriculture 2007a). Yet its contribution in the overall economy follows trends in the state. The Wyoming Employment, Income, and Gross Domestic Product Report indicates a loss in agricultural income in 2007 and indicates that farm work employs just 1,100 of the county’s 24,040 people (State of Wyoming 2009, 10,25).

Within Fremont County, tribal members operate 206 out of 1,394 farms, or roughly 15 percent. They utilize 503,087 of 1,800,538 acres, or 28%. Crop sales, however, average only $723,000 of $22,379,000, or 3% and livestock sales $5,774,000 of $64,322,000, or 9%. Revenues are disproportionately low relative to farms in the rest of the county (U.S. Department of Agriculture 2007a).

Livestock numbers have decreased since Wilson’s 1973 report on the success of Indian ranching when 19,697 cattle grazed tribal lands (7,225 owned by the Arapaho Ranch) and nearly all range units were utilized by tribal members. The 2007 agricultural census reports 12,422 cattle owned by tribal
members. The Arapaho Ranch, operating since 1940, entered a niche cattle market in 2009, supplying high-end organic beef to all of the Whole Foods stores in the Rocky Mountain Region (Stoner personal communication 2009). It is the largest organic, grass-fed cattle ranch in North America, covering 600,000 acres, owned and operated by the Northern Arapaho Tribe.

Midvale Irrigation District, which serves Riverton Project lands, diverted 321,098 acre-feet of Wind River water in 2007. Its largest crop was alfalfa in acreage and value. Other hay, sugar beets, silage, and beans brought in the most revenue (Midvale Irrigation District 2007). Crops fluctuate with national markets, which include the bean market of Mexico, and the confectioners sugar market supported by sugar beets (Dechert personal communication 2009).

New West trends are certainly affecting the region. Land values are increasing in the upper end of the basin, where wealthy buyers are purchasing vacation homes; and lands outside of Riverton are being subdivided into smaller lots (Dechert, Urbigkeit, Wilkes and others, personal communication 2009). While agriculture is part of the region’s identity, legacy, and draw, the economy is reflective of New West economies. Farming, fishing and forestry employ only two percent of the population; management and professional activities 33.9 percent; service occupations 17.7 percent; sales and office occupations 22.5 percent; construction, extraction and maintenance 12.7 percent; and production and transportation 11.2 percent (Bureau of the Census 2000b). The service economy clearly plays a stronger role than the natural-resource based economy that historically supported the region, except in terms of regional identity.
Water flows much the same as it did in 1970. The court battles shifted the dynamics of power briefly, and then returned them to irrigation equilibrium. O’Gara writes, in his 2000 chronicle of the court battles, “the big issue—the tribe’s ability to take charge of their substantial water right in the Wind River Basin and change the ways of the valley—lies quiet, and the state engineer runs the river” (O'Gara 2000, 244). He implies that change will come as time passes, as the basin changes, and with a public “less impressed with the economic importance of agriculture and more impressed with scenery…” (256).

A Dynamic Environment

Evolving human-environmental interactions have produced changes seen both as benefits and detriments. Crop yields, for example, are much greater than in the past. High-quality domestic drinking water is available for most basin residents. Yet several cumulative effects of environmental change have had negative consequences, leaving legacies that will last for years. Extremely low river flows, changes in ecological conditions, and the health-related impacts of chemical contaminants point to problematic land use trends of the past century. The following discussion focuses on these to exemplify the way the environment continues to respond unpredictably, in long-term ways. At the same time, changing human values and activities elicit new responses from the environment.

Stream Pulse: Discharge rates along the Wind River reflect a more managed environment (Figure 2.41). Historic high flows disappeared. In the 1920s, prior to substantial irrigation development, the hydrograph peaked at
almost 6000 cubic feet per second (cfs) in June. During the 1980s, the decade’s average never exceeded 2000 cfs, less than 1/3 of the average peak flow in the 1920s, and the 1990s measured just over 3000 cfs, approximately half of historic flows. Simultaneously, the low end of the hydrograph dropped and its seasonal low shifted from winter months to early fall, when irrigators still drew water from ditches. The river first experienced extremely low flows in 1938, when it first dropped below 100 cfs. In 1948, the flow fell to 18, but both these events were anomalies. By the 1970s, the situation had reversed. All but three years show flows of less than 100 cfs and during the 1980s, every year reached flows below 100 and as little as 12 and 13 cfs flowed past the Riverton gauge (U.S. Geological Survey 2010) (Figure 2.41).


Overgrazing: Overgrazing in the basin during the unregulated livestock era had permanent environmental impacts. A land planning and classification report from 1950 reads, “In this semiarid region complete recovery is expected to be
slow, probably taking as long as 50 years or more since only slight recovery from past overuse has taken place during the past ten years” (Missouri River Basin Investigations Staff 1950, 45) and a 1947 land classification report is slightly more pessimistic (Bureau of Land Management 1947, IV). It emphasizes the relationship between overgrazing and erosion:

…attributable mainly to widespread deterioration and in some places outright destruction of native vegetation during the past sixty years. On most range lands the thin vegetative cover is gradually improving… Nevertheless, in certain localities, notably in Badwater watershed, forage still remains in generally poor condition and in some places it is virtually exterminated due to overstocking, unseasonal use, and excessive sheep trailing. Valuable grasses on much of the range have been partly replaced by economically inferior or worthless grasses, half shrubs, and annual weeds…

Tie Drives: The tie industry also left its footprint by harvesting millions of trees and floating them downriver to Riverton during seasonal high flows. While very little attention has been given to environmental impacts on the Wind River itself, Ellen Wohl discusses tie drive impacts further south on Front Range rivers in Colorado in her book *Virtual Rivers* (2001). It should be noted that the Wind River is different than waterways described by Wohl, particularly in its lowlands. It is wider, its timber is deciduous, not coniferous, and it is not, in this discussion, a mountain stream. I include her discussion here because some of the effects of tie drives further south inform environmental relationships between stream morphology and tie drives as a whole. For example, she notes that “It was common practice to facilitate the downstream movement of ties by altering irregularities along the rivers.” The Wind River tie drives sometimes used
dynamite (Goodman 2002, 26). Wohl indicates that streams that had experienced tie drives tended to be 1-3.6 times wider with less organic debris and less developed banks and pools. These rivers provided less cover for fish and aquatic organisms and had less streamside habitat and overall diversity” (94-101). The United States Fish and Game officials based in Lander believe the tie drives had a permanent impact on fisheries of the Wind River (Skates personal communication 2010). In addition to the drives themselves, contamination of the tie treatment facility is a local concern.

**Contamination:** While basin residents reference fracking (or hydraulic fracturing, the injection of various fluids to fracture rock in the process of oil or gas extraction), irrigation return flows, and other sources of water contamination, the uranium mill tailings site in the Arapahoe/St. Stephens area is called the “most contaminated spot on the Reservation” (Wind River Alliance 2006). The 1978 Uranium Mill Tailings Radiation Control Act required cleanup of tailings sites, assigned to the Department of Energy, which removed and capped tailings at the Riverton site. Their compliance strategy now involves “natural flushing” which allows contaminated groundwater plumes, which contain h chromium, molybdenum, selenium, radium, uranium, and net gross alpha, to naturally dilute and dissipate underground over a period of 100 years (U.S. Energy Information Adminstration 2005). Many tribal members feel this strategy is insufficient. While domestic wells have been replaced with a municipal water supply, many Arapahoe residents express concern for their health. The EPA is funding an
environmental justice grant to raise community awareness of the contamination. The Wind River Environmental Quality Commission found that 13 different contaminants exceeded health standards in the groundwater plume. They additionally found evidence of high levels of sulfate, manganese and uranium in a surface water oxbow lake where children swim (Wind River Alliance 2006).

While water diversion, cattle grazing, tie drives, and uranium development was all seen as beneficial economic pursuits earlier in the century, not everyone now sees these practices in a positive light. Residents express very mixed opinions of various industries and the way they operated in the shared environment of the basin. Yet the environmental changes they produced are not just a result of the industry; they are a result of more invisible forces including cultural preferences, power dynamics, and the consequences of operating in a capitalist economy. The dynamic environment is the relationship between dynamic ecological systems and human preferences. Humans, the environment, and their combined relationship endlessly and unpredictably evolves.

Conclusion

It is easy to simplify relationships because of lines drawn on maps, particularly when the lines represent “moral” geographies, or lines dividing what we perceive as right and wrong. Donald Worster, for example writes,

There is nothing harmonious, nothing picturesque about the western world that has developed beside the irrigation ditch. There is little peace or tidiness or care, little sense of rooted community. There is no equitable sharing of prosperity. The human presence here often seems very much like the tumbleweeds that have been caught in the barbed-wire fences: impermanent, drifting, snagged
for a while, drifting again, without grace or character, liable to blow away with a blast of hot desert wind (Worster 1985, 6).

His depiction of the Friant-Kern Canal as typical of irrigation ditches, lined with concrete, void of vegetation, fish, birds, and animal life is simplified by an external eye, and it is unfair. This chapter refutes the idea that, “The modern canal is not an ecosystem” (Worster 1985, 5). Cultural landscapes are ecosystems, and their policies, external pressures and internal interactions influence the human-environmental patterns of these places.

Many scholars, authors, lawyers and even judges have described the inequity between the Riverton Project and reservation lands, and taken moral stands. Teno Roncalio, the court appointed special master to the 1992 Wyoming Supreme Court case writes, “the Riverton Reclamation Project, largely non-Indian, to date has received $70 million of federal funding during the same period that $4.4 million was spent on Indian systems” (1993, 210). Geoff O’Gara’s notes that “the major reclamation projects, and the major dollars, had a way of sliding off the Indian side of the ledger and onto the non-Indian side” (2000, 249). Most pointedly, United States Supreme Court Justice Brennan, in his dissent of a draft opinion involving later water disputes writes, referring to Wind River water, “The Court might well have taken as its motto for this case the words of Matthew 25:29: ‘but from him that has not shall be taken away even that which he has’” (Mergen and Liu 1997).

The intent of this chapter’s discussion is not to again emphasize the blatant cultural inequities in water development in the basin and the way morality
tends to weigh in the worth of water, splitting down cultural lines. The north and south sides of the river are divided in this chapter, and government investments highlighted, not to villainize non-Native settlers or discredit worthy lives, but to link the way power dynamics (“geographies of exclusion”), cultural dynamics, and economic shifts relate to environmental change and the evolution of specific human-environmental relationships. This discussion concludes the chapter with what I believe is a more complicated narrative of division and interaction amidst changing ecology along the river.

**Geographies of Exclusion:** Geographers have made mistakes in generalizing differences in cultural geographies, particularly in deterministic ways. American Indian historical geographies are particularly challenging, as archives are filled with documents written with a Euro-American pen. Still, it is important to discuss cultural differences and their environmental relationships, with care. I use Cole Harris’ fourth chapter of *The Resettlement of British Columbia* (1997) as a guide. He uses archival information and cultural geographies to reflect on power relationships in the Fraser River Canyon and their relationship to local geographies.

Harris describes the introduction of unfamiliar systems of power into the Fraser River Canyon as colonialists controlled indigenous populations first through outright violence, and later by more subtle systems of land ownership and law. Harris suggests that the Nlha7kápmx people were trapped in “political economies of detail” (Harris 1997, 131 from Foucault 1979, 139-141) they little
understood, as their homeland became a changed place, out of their control, strategically shaped by “geographies of exclusion” (Harris 1997, 136).

Harris’ terminology sheds light on geographies of the Wind River Basin. In 1905 the Indian Service filed for water rights on behalf of the tribes for 32,000 acres under the Wind River Ditch (Indian Service 1916a, 9). Another branch of the Department of the Interior tried to persuade Congress to transfer the funds for the ditch that did not yet exist, along with its water rights, to what would become the Riverton Project. Simultaneously, the government was in the process of allotting lands in parcels that ranged from 320 acres to 160, 80, and 40 acres, and additional 80 acre “companion tracts” with 20 acres in a separate irrigated area (Wilson 1973, 255-263).

The tribes had recently endured starvation, disease, and population declines. They had ceded over half of their reservation. Neither tribe numbered more than a thousand. It is baffling to consider how tribal members would even measure an allotment of 160 acres, understand a convoluted system of water rights based on a project that did not yet exist, and meet basic needs when access to food and water was not all that straightforward on all allotted lands.

Land allotment, O and M charges and water rights were pawns of political economies of detail that supported the maintenance of a power dynamic in which government officials and non-Native settlers always had a better understanding, and thus an upper hand.

The Second McLaughlin Agreement provides the most obvious example of a “geography of exclusion” in which a massive irrigation system was
developed with government funds once lands were out of Indian control. More
subtle geographies of exclusion also existed. A newspaper article from the
Riverton Review (1944), reports that Indians were refused service at all but one
small restaurant in town and laments the consequence “that the Indian business
in general is being forced out of town by the situation.” To remedy the problem:

A resolution was passed by representatives of the attending
organizations stating that the town in general considers the business from the Indians an asset to the community, that members of the Indian race are American citizens, a number of whom are serving in the armed forces, and recommending the practice of race discrimination cease.

Geographies of exclusion were reflected on many scales, affecting everything
from eating locations to millions of acres of land.

An archival correspondence concerning the sale of deceased Indians’
allotments to non-Native settlers reads:

Since the department began the sale of the lands of deceased Indians in the Wind River Reserve and settlers began to buy the same, it has become necessary to spend a considerable amount of money for laterals to supply the lands so sold… This condition of affairs has resulted in the expenditure of such an amount for laterals that the funds on hand available for this purpose for the remainder of the fiscal year are comparatively small (Mondell 1915c).

In this case, settlers were allowed to buy lands on the reservation, excluding
tribal members from the lands they still owned, and irrigation was provided at
considerable expense so that settlers could farm.

These geographies of power had ecological consequences. Another 1915
correspondence from Congressman F.W. Mondell to the Commissioner of Indian
Affairs writes:
The opening of farms on the lands of deceased Indians sold to white settlers has very materially improved the appearance of the reservation, not only by reason of the improvement thus directly made, but also by the encouragement it has given the Indians to improve their own lands in the same localities... (Mondell 1915a).

The preceding correspondences raise some interesting questions, since lands allotted to tribal members were to be held in trust by the United States government for 25 years. It is unclear why these lands were sold by 1915, when most were allotted in 1905. Regardless, the point is that when they were sold, land use changed, and the power dynamic favored farmed land as opposed to Shoshone and Arapaho land that reflected the preferences of its members.

Yet the tribes, though operating within a power dynamic that would never fully honor their equality, held their ground and visibly shaped geographies. Their more communal and democratic ethic did not lose its vitality. The amount of land still held in joint tribal ownership, the "heirship problem", and the 300,000 acre Arapaho Ranch (now providing organic beef to all Whole Foods stores in the Rocky Mountain Region) are all examples of a communal land ethic that endured an era when the government pushed Native American communities toward capitalist economies amidst a private property ethic (1868-1934).

The government pressured the two tribes to govern through one body, but they consistently refused and "resisted some assimilative procedures instituted by reservation agents and embraced others, as fit their needs" (Flynn 1998, 40). In 1934, the Indian Reorganization Act passed, which ended the allotment era and worked to rejuvenate tribal government nationwide (Pevar 2002, 10). Tribes
across the nation were given a year to accept or decline provisions of the IRA. The Wind River tribes, with a great deal of mistrust for the government, declined. Among other things, this meant that their “constitution” did not have to be approved by the Secretary of the Interior. The tribes still govern uniquely; the tribal business councils are limited in scope and must bring “non-customary matters” before general councils, which consists of the whole tribe, the “sovereign political power” within tribal government (Flynn 1998, 39, 44-45). The tribes did not give up their sense of democratic and communal governance.

Federal Indian policy in the 1930s is reflected in change on the Wind River Reservation. There is evidence that government officials made more of an effort to work through, and not against, tribal values. Superintendent Stone, in his Proposed Ten Year Program for the reservation (1946-1955) writes:

If we hope to gain acceptance by the Indian groups of these proposals, we will need to watch carefully our approaches, and I question whether it would be wise to seek to obtain this objective through a limited number of Indian leaders. In a spirit of mutual understanding, the entire group will need to respond to such planning in the spirit of the true democratic way that is so deeply installed (sic.) in the Indian person through long generations of Tribal government (Stone 1944, v).

Stone’s program worked to incorporate these democratic values in his ten year plan, including the grouping of homes as cooperative enterprises:

Just as the primitive conception of food as the property of all has carried over into modern life to such an extent that food given as a relief measure is shared with friends and relatives, so the idea of land ownership by the tribe is still a strong Indian concept, and the respect for group authority, so potent a factor in primitive community organization, is still a predominating force in the Wind River Indian tribal life (vi).
Resource Based Capitalism: Many geographers and historians believe that capitalism, and its fluctuating commodity markets, is central to understanding the American West and its changing environmental landscape (Robbins 1999; Cronon 1991). Robbins writes:

> For the last three centuries capitalism has been the most revolutionary force the modern world has known. Its propensity for technological dynamism and endless innovation; its pursuit of ‘new spaces’ as markets, sources of raw material, and labor power; and its capacity to manipulate the physical world have contributed to insecurity, instability, and endless disruption to the people and places it has affected.

Yet capitalism, and particularly resource-based capitalism, is not just an imprint on a landscape where timber was removed or cattle were grazed. It is not just a transportation network of trucks, planes and trains. It is, as Robbins writes, “a mode of consciousness” a “sense of reality” and “a body of ideas and values.” Wyckoff describes the way these values transformed Colorado’s settlement geography, emphasizing (1999, 287-288):

> …the resulting spatial patterns represented neither a coherent regional plan of development nor the spontaneous and providential expression of a frontier populace; rather, they resulted from thousands of decisions by ordinary Coloradans whose lives were oriented around broadly shared, mostly unchallenged, and individually realized goals of capital accumulation and regional economic growth that, with almost breathless rapidity, reconfigured Colorado’s fundamental areal organization within a few decades.

The invisibility of the capitalist value system makes landscape transformation seem inevitable. The ownership of property, and the rights to water are seen as God-given rather than socially constructed.
The capitalist economy (alongside power dynamics and cultural preferences) shaped human-environmental relationships in the Basin since it was introduced in the 1800s. The Riverton Project developed alongside railroads; crops were instantly linked to national markets, which rose and fell with fluctuating supply and demand. Barley fed the beer industry in the 1970s, beans now feed Mexican demand. Commerce became more mobile and global, and the basin’s resources did too.

Resource-based capitalism often monopolizes inexpensive public resources, which is certainly true in the Wind River Basin. The livestock industry’s sheep and cattle grazed ceded reservation lands for years without permits, stripping lands of grasses, shipping animals out on trains and pocketing profits. Likewise, the tie industry chopped millions of trees in the national forest, which benefited both the Wyoming Tie and Timber Company and the Chicago and Northwestern railroad. Public lands subsidized these industries.

Social and Environmental Change: Capitalism, power dynamics, and cultural preferences are invisible forces of social and environmental change. Perhaps the most tragic example of the interaction of the three in the Wind River Basin is the legacy of the uranium mill tailings site near where the Little Wind River and Wind River merge. While “economic ‘structures of sin’” is an overly laden term used by an archbishop (Robbins 1999), it highlights the way economic geographies overrule moral geographies. The tailings were not from their lands, the mill was not their company, and while a few tribal members may have briefly
benefited from short-term employment opportunities, the much more detrimental long-term consequences are all theirs.

Conversely, the Arapaho Ranch merges capitalism, power dynamics, and cultural preferences in altogether different ways. Since the 1940s, the Arapaho Ranch has operated as a tribal industry, grazing cattle on tribal lands. After receiving organic certification, they have invested in a niche New West market, which pays more for its conscience; ecologically sensitive grazing practices draw consumers who are willing to spend more for their meat.

New West economies are still embedded in capitalism. They do not remedy social inequities of past economic practices. Rather, they are often related to the continuity of historical patterns (Limerick 1987). Robbins writes (1999), “The surface changes that have taken place in parts of the rural West have sharpened class differences, deepened the economic crisis for many of the local population, and emblazoned on the landscape new patterns of social inequality.” It is unclear if the Wind River Basin will similarly respond.

The Wind River Basin’s complex cultural landscape combined with its location in one of the most treasured ecosystems in the United States results in unique human-environmental relationships. Some of these relationships are shared by all basin residents. Some are localized, some are culturally-based. All of the relationships are dynamic, ecologically and socially. They are constantly evolving from continuous histories, which have always revolved around power, culture, and the movement of capital. Water has always been central to habitation
in the basin, both shaping and shaped by these invisible forces. The Basin is a
crazy quilt of relationships; its stitches, perhaps, are the streams.
CHAPTER 3

YOO-AH, DYN (THE WARM VALLEY, SHOSHONE), NIITIINE’ETII-NO’ (WHERE WE LIVE, ARAPAHO), THE WIND RIVER BASIN: THE ROLE OF PERCEPTION IN ENVIRONMENTAL CHANGE

Figure 3.1 Flora Dewey (Arapaho) takes a photograph of the Wind River Basin through her windshield. The image represents “niitiine’eti-no’”, the Arapaho “place where we live.” Arapaho Culture Center, 2008.

This chapter explores perception as a fundamental component of environmental change in the Wind River Basin. Building on prior discussions of environmental change and its historical relationships, this chapter turns to more “invisible” landscapes of place identity and deep rooted cultural values (Figure 3.1). Understanding the relationship between perception and environmental change is critical, as Alessa et al. (2008) write, “Global environmental change,
particularly in water resources, exists as both perceived and measured conditions. Of these two, the former is more powerful."

The role of place perception in environmental change is difficult to examine not only because the topic, though well explored, is often vague and broadly defined (Zelinsky 1973, 36-64; Meinig 1976), but also because it is impossible to write objectively about human perception. Regardless, place perception is a key factor in understanding place and avoiding environmental, economic, or any other kind of determinism. In this discussion, “place” refers to “the process by which people give meaning to location, particularly to how they create social geographies that are rooted in community” (Wyckoff 1999, 6) and place identity is then the way we know and recognize ourselves, and are known and recognized by others, with respect to place. Place is created by the complex interaction of physical environment, historical geographies, and the “invisible landscape” of value systems, cultural beliefs, experiences and interpretations of place. Kent Ryden notes (1993, 40), “This sense of identity may be one of the strongest of the feelings with which we regard places… this feeling of identity helps give order, structure, and value to the geographical world.” Likewise, this “invisible landscape” shapes the visible world.

This exploration of place perception fills four holes in this dissertation’s discussion of vegetation change along the Wind River. First, the chapter prior to this presents a place-based history that focuses on large-scale land exchanges, regional economies, government policies, transportation networks and other large forces affecting place. While important, it overlooks individual histories that
may run counter to regional trends, operating on a completely different scale. The stories that occur on a much smaller scale are important; they inform the way larger-scale events affect individual lives as well as the way that different individuals within a region respond to change. They remind us that many voices are necessarily lost in the scale of metanarratives. Though each experience may not represent common experience, all experiences matter and shape place. Some of these voices are included here.

Second, place perception helps us understand the underlying “moral geographies” that shape place. When basin residents express, for example, that “water is a gift, not a right” (Redman personal communication 2008) or “Irrigable land not in production has no value either to the Community or to the owner” (Gerharz 1946, 34), they present moral geographies. The Nature Conservancy’s mission to preserve the diversity of life by “protecting the lands and waters they need to survive” (The Nature Conservancy 2010) reflects a landscape of the mind, an ethic. As Keith Basso writes, “beyond the visible reality of place lies a moral reality which they themselves [Apache people] have come to embody…it is this interior landscape—this landscape of the moral imagination—that most deeply influences their vital sense of place, and also, I believe, their unshakable sense of self” (1996, 146).

Third, place perception helps us better understand the deep roots of conflict. Again, Keith Basso writes:

Ubiquitously accepted as natural, normal, and unexceptional, sense of place is variously trained, variably intense, and, having grown to mature proportions, stoutly resistant to change. Its
complex affinities are more an expression of community involvement than they are of pure geography, and its social and moral force may reach sacramental proportions, especially when fused with prominent elements of personal and ethnic identity (1996, 148).

Environmental conflicts are often conflicts of perception, and a study of perception helps us incorporate powerful emotional realities into change and resistance to change.

Fourth, current cultural landscapes are largely relics of past value systems; current value systems help us predict evolving futures. Investigating place perception not only allows us to understand changes in human-environmental relationships over time, it indicates (but does not determine) the future of place.

This chapter builds on the work of several geographers and historians. Nancy Langston and Richard White unravel the way various groups of people have perceived and managed the Malheur Wildlife Refuge and Columbia River, respectively. Ian Tyrell’s True Gardens of the Gods: Californian-Australian Environmental Reform, 1860-1930 (1999, 103) emphasizes that “For the historian of popular environmental thought, irrigation is not about drains, pumps, pipes and dams, but about dreams.” Joseph Wood’s New England Village (1997) depicts the way we not only construct our current realities, but how we also invent our histories, legitimizing our present with pasts that may never have existed. We create our own geographies. “Literally and figuratively,” he writes, “we build our own worlds” (137). Wyckoff and Nash (1994) show that these worlds change over time; in their examination of Harper’s Monthly 1850-1900,
they find that popular images reflect the changing perception of Western American geography over time. Finally, and most importantly, geographers Yi-Fu Tuan and Kent Ryden inform this work. Yi-Fu Tuan’s seminal work, *Topophilia* (1974) explores human perception, attitude and value as it relates to environment. Its purpose, Tuan writes, is to promote self-understanding, without which “we cannot hope for enduring solutions to environmental problems, which are fundamentally human problems” (1). The work of this chapter is based on his belief. Ryden’s *Mapping the Invisible Landscape* investigates “the meanings which people assign to the landscape through the process of living in it” (1993, 38). Ryden exemplifies how the personal narratives and “verbal lore” (206) of people in Idaho mining towns map landscapes that are not immediately evident to the outside eye. He suggests that these landscapes give us identity and order our worlds. His informal interview methods indicate that there is much to be learned by examining personal narrative.

This chapter additionally builds upon scholarship that specifically addresses the role of local place perception alongside physical investigation of environmental change. The use of Traditional Ecological Knowledge (TEK) in ecological studies, though not without scrutiny from locals and scientists, increasingly validates the use of local knowledge in research. TEK is defined as “a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment” (Berkes, Colding, and Folke 2000). Many scholars use TEK to
bolster Western scientific methods because it offers more regular observations of local processes, examples of adaptive management techniques, an extensive historical “library of information”, and more comprehensive understanding of interspecific relationships than purely Western scientific methods (Moller et al. 2004; Berkes, Colding, and Folke 2000; Nabhan 2000). Alessa et al. (2008) address perception as more than just a means of measuring and managing ecosystem processes more effectively; they investigate the ways perception relates to environmental change. They conclude that perception mediates a human willingness to act; we base our decisions on our perceptions, though these perceptions may not be accurate or complete.

This chapter explores place perception through 17 semi-directive interviews of 23 people who live in the Wind River Basin and represent different cultural, political and economic groups. Semi-directive interviews are intended as conversations more than formal question and answer interviews. They are guided by interviewers, but shaped by interviewees as they make their own associations. Questions may deviate from those intended, there is no time limit, and topics vary with the interviewee’s level of interest and expertise (Huntington 1998, 2000). The relatively informal nature of a semi-directive interview encourages broad associations not foreseeable by the interviewer, difficult if not impossible through more formal interview methods. Interviewees were selected based on their cultural affiliations (Eastern Shoshone, Northern Arapaho, Euro-American), their geographical location (Crowheart, Ft. Washakie, Ethete, Arapahoe, Riverton), and their occupation (farmer, rancher, expert in cultural
knowledge, former councilmember etc.). This list is not comprehensive. It is intended to represent a diverse sample of different perspectives of place within the Wind River Basin but by no means represents every perspective and experience. Interviewees were asked the same series of questions, though additional questions occasionally added according to their expertise and deviations were encouraged. Emails, phone calls, and in some cases additional visits were conducted to clarify interviewees’ points of view. Interviewees were informed that interviews would not be anonymous, unless requested. Two interviews were not recorded at the request of interviewees; two were not recorded due to faulty equipment. Notes were taken in non-recorded interviews and several follow-up emails clarified statements of the interviewees.

Interviewees are listed below by name, occupations, location, and (if applicable) tribal affiliation. Two sets of interviews were conducted, the first in August and September of 2009, the second in January of 2010. Interviewees are as follows:

Don Aragon and Kassel Weeks, Wind River Environmental Quality Commission, Ft. Washakie (Eastern Shoshone)
Lars Baker, Supervisor of Fremont County Weed and Pest, Riverton (Euro-American)
Richard Baldes, Conservationist, former U.S. Fish and Wildlife Employee, Ft. Washakie (Eastern Shoshone)
Jolene Catron, Executive Director of Wind River Alliance, Lander (Laguna and Navajo)
Randy Craft, Land Conservation Specialist, the Nature Conservancy, Lander (Euro-American)
Berthenia Crocker, Arapaho Tribal Lawyer, Lander (Euro-American)
Lloyd Dechert, Farmer and Midvale Irrigation District Board Member, Riverton (Euro-American)
Joyce Duran, Elder, Arapahoe (Northern Arapaho)
Valeria “Cathy” Gervais, Librarian, Crowheart (Eastern Shoshone)
Rachel Grant and Sherry Blackburn, Arapaho Water Office, Ethete (Northern Arapaho)
Geoff O’Gara, Author What you See in Clear Water, Lander (Euro-American)
Iva Redman, Arapaho Culture and Language Specialist, Arapahoe (Northern Arapaho)
Dave Skates, Scott Roth and Pat Hnilicka, Staff of Lander Office, United States Fish and Wildlife Service, Lander (Euro-American)
Reba Teran, Elder and Shoshone Language Specialist, Ft. Washakie (Eastern Shoshone)
Ralph and Eileen Urbigkeit, Ranchers and (Ralph) Former Legislator, Crowheart (Euro-American)
John Washakie, Author, Former Shoshone Councilman, Ft. Washakie (Eastern Shoshone)
Ben L. Wilkes and Karen Wilkes, Ranchers, Crowheart (Euro-American)

Interview questions centered on three main topics: assessing perception of present vegetative landscape, assessing perception of present cultural landscape, and assessing perception of social/ecological change. Additional questions focused on the interviewee’s field of expertise. Each interview was transcribed, reviewed in the context of all 17 interviews and categorized by theme. Common themes, relevant to the interests of this dissertation, were grouped together and provide the structure of this chapter.

This chapter consists of three parts. The first explores various perceptions of vegetation among interviewees in seven categories that explore agricultural plants, culturally significant plants, other riparian plants, and plants classified as weeds. The second part of the chapter addresses broader issues of riparian change, highlighting what interviewees believe to be the greatest influences on
riparian areas over the past century. Finally, this chapter concludes with a discussion of the themes and examples explored by the interviewees.

Part I: Perceptions of Vegetation Change in the Wind River Basin

Agricultural Practices

Figure 3.2 Arapaho boys walk through a barn at the Arapaho Ranch. Agriculture plays a central role in regional identity.

Economically, agriculture contributes very little to Wyoming’s GDP; agriculture, forestry, fishing and hunting combined comprise only 1.3 percent, (State of Wyoming 2009) and Fremont County reflects the state trend. The only nationally notable crop in the Wind River Basin is hay, which is first in the state and 28th in the nation (U.S. Department of Agriculture 2007a). However,
agriculture covers an enormous amount of land in Wyoming, which ranks eighth nationally in total land in farms and ranches (U.S. Department of Agriculture 2007b, 22) and Fremont County has more farms than any other county in Wyoming, nearly 1,400 (30). Agriculture plays a large role in regional history, and interviewees indicate that agriculture is central to place identity in the Wind River Basin.

The majority of interviewees have personal experiences involving agriculture, whether as full time, lifelong farmers and ranchers (Ben Wilkes, Ralph and Eileen Urbigkeit, and Lloyd Dechert), or through more peripheral experiences or childhood memories of family land (Rachel Grant, Sherry Blackburn, Reba Teran, John Washakie) (Figure 3.2).

Several interviewees describe agricultural change in terms of evolving farm technology and the capital required to obtain it. When Ralph U. recalls the changes in agriculture over his lifetime he gestures toward all of the farm machinery gathered outside his house:

Just look at that line of machinery out there! It used to be two teams of horses, walking plow and a mowing machine. On our first application for an FHA loan right after we was married, sixty-some years ago, I listed a team of horses as assets. That was enough to get a loan. I could borrow 3500 dollars. That’s all the FHA would loan me in those days…now it’s three or four hundred thousand dollars! Buy land, buy this and buy that, and that first loan was 3500 dollars.

Lloyd D. has similar memories:

When I was a kid you had a plow and you had a harrow. Now they got a roller harrow. You used to drag three or four railroad ties behind a tractor to get it level. They don’t do that anymore, see. But it takes money to do that and it takes a crop to pay for
it. And my folks were well educated both of them and they still pretty much struggled in agriculture for most of their lives. They fed a lot of cattle...there were five of us kids, we put up all this hay in the summer time... our labor was for nothing, and in the wintertime, [my father would] have these guys bring cows in and he’d feed them... That’s how they made their living. We’d have 4000 head of cows in here and they’d feed them all winter. Then in the summer time the cows would leave, somebody else owned them, no taxes, then next summer we’d raise more. That’s how we did it, see. In the latter—oh I would say from about the mid 50s to the late 60s—there was a lot of that. This is good country to winter in. It’s pretty much an open winter. That’s how they survived.

John W. remembers using a buck rake with horses, using horses to cut, rake and stack, until they switched to a Ford tractor in 1955, “I have done a lot of pitching hay to build a stack and feed.” He explains:

In the 1950’s, we would be excused from school to gather and drive cattle to market over at Hudson. Before that my father and uncle would take them to Shoshoni...Most of my summers were spent in the high country, pushing cows, hunting and fishing. We went everywhere on horseback. My parents had over forty head of saddle horses and never over thirty cows. We thought we were big ranchers.

Reba T.’s father raised cattle and hay near the Little Wind River and leased his land in Crowheart:

My Dad raised hay in our small five acre field and also on our other land which was 80 acres, but he only planted hay on about ten to fifteen acres...I remember back in the old days when we were kids our hay would grow at least 5 1/2 feet tall. It was so tall that we had to stay on our trails. And he could get a haystack out of that little five acres!

Rachel G.’s family raised sheep and hay near Mill Creek:

My grandpa had sheep. When my mom and them were growing up they used to tend sheep, and they used to have a goat for cheese and milk, and they used to have a milk cow.
John W. remembers sheep with a less than romantic eye, “I hated it,” he says, “Lambing—oh God—that’s the worst season there is.

Early farm operations supported families and the local economy. John W. remembers it as “a time when we were all about the same financially and struggling.” He remembers using most of the hay they put up though “some families sold to one another.” Gradually farmers began to trade in larger markets.

Lloyd D. explains:

We always had pigs and cattle and we had some sheep. We had trouble with the sheep because the price was so bad and we had a lot of coyote problems but you’d fatten the cattle and then truck them to Denver or somewhere like that, and the pigs—there was a slaughterhouse locally that bought some of that stuff—but you raised the grain to put in the hogs and put in the cattle and about the only cash crop you had was beans. My folks had potatoes when I was real small. But it doesn’t take a lot of potatoes to saturate the market because you can grow a lot of potatoes on an acre. And that wasn’t necessarily a cash crop. You stored them and people would buy them from you to get through the year. Later on, they would send them to Idaho to have them reprocessed.

Interviewees also commented on their growing familiarity over time with the distinctive, local environmental niches found within the basin. They noted how it took time to understand the subtle changes encountered in just a few miles between localities. As agriculture developed in the early part of the century, the Wind River Basin divided into two different agricultural regions, largely based on climate; the upper Wind River Basin remains a cooler hay-growing region, while the lower basin was warm enough to support both hay and cold climate crops. As Ralph U. explains, “They always figured Morton Lake was about the frost line for your row crops. Anything west of Morton Lake, the frost is
too late to raise that stuff, if you stay east of Morton Lake you can get away with it down there.” Rancher Ben W., who was raised near Pavillion and moved upriver to Crowheart in the 1980s, says:

Well, I tried corn the first year or two I come up here. You wouldn’t believe it just 20 miles away—but you can’t grow corn up here. You can grow it, but it’ll never get kernels on it. It will freeze in the spring or freeze in the fall, catch about a week on each end. So the growing season is probably at least 20 days different than it is in Pavillion.

Interviewees adapted farming practices with new technologies, which changed agriculture tremendously. Lloyd D. explains, “We can raise so much more hay now than we could 20 years ago, and it’s not any one thing. It’s everything. It’s the plant itself, it’s the seed, it’s the fertilizer. When we have a cool summer we get fantastic yields of hay.”

Ralph U. describes how fertilizer revolutionized agriculture. Prior to fertilizer “your grass didn’t grow much. It was just old stumpy stuff and if you cultivated some, why it would grow a little bit better. Alfalfa did good. Thirty bushels an acre was the maximum you could ever get out of oats, now it’s over 100, but you got fertilizer now.” Ralph U. remembers his first shipment of fertilizer.

…they charged me as much for freight from Billings down here as the fertilizer…because they said it was so explosive. A year or two before that in Texas City, Texas a ship full of nitrogen fertilizer blew up and killed a couple hundred people and they figured nitrogen fertilizer was just a terrible—and it is—it was an explosive. But when the ship caught on fire somebody says ‘oh you can put that out if you pour diesel fuel on it.’ Put diesel fuel on nitrogen, you just make a bomb, and it was a bomb. They could have put water on it and put it out, but they poured diesel on it and it blew up Texas City. I think it killed several hundred
people. Just flattened it. But anyway, I got a half a dozen sacks of nitrogen fertilizer from Billings, had it shipped down for me, and the freight on it was about as much as the fertilizer because it says this is a dangerous substance and we have to charge extra. So I put it out in back and run it through the grain drill. They said you put it through the grain drill and if there’s a spark or anything on the gears it’s gonna blow your whole grain drill up. Oh, it was scary.

The results were astounding, “Next year I put all I could get on my brome grass. That’s how good it was, that first half a dozen sacks. That was amazing.” Ralph U. now puts up at least three times as much hay as he used to.

Lloyd D. lists the three most profound changes in agriculture as the invention of anionic polyacrylamide erosion control granules (PAM), genetics of the seed, and changes in equipment, “I mean there’s a piece of equipment that will do just about anything you want.”

PAM prevents soil erosion, and dramatically decreases labor. Lloyd explains, “The biggest improvement in agriculture in my lifetime is this PAM that they put in the water to keep it from eroding… That has taken the shovel work out of irrigating. In my operation, that is the best thing.” Lloyd explains the changes PAM has made to farm labor, “When I was a kid and even when I was farming for myself we’d be out there two or three hours a day straightening rows, making that water get to the bottom, especially if it had new seeding in it because if it didn’t get to the bottom you didn’t get a stand.”

Lloyd D. equally marvels at changes in seed. As farming techniques change over time “the plants kind of change with it. The plant changes as Mother Nature lets it change. It adapts to the situation or else it disappears. It's amazing
how that works.” Lloyd D. describes how alfalfa seed was modified to tolerate soil alkalinity:

Years ago if your ground was over seven and a half pH or in that area they’d say hey your pH is getting too high, you’re gonna have trouble raising hay. Now that figure is almost eight. You go out there and sample this soil and you’re gonna find that most of it is ground is between seven and half and eight. Some of it will be at eight.

Lloyd attributes this change to plant genetics, “The University of Wyoming did some really extensive work in that area.” Lloyd D.’s alfalfa was involved in genetics research in which a researcher worked in Lloyd’s field:

He was out here in my alkali spots digging up alfalfa plants to take down there to grow to start seed to where he could develop a seed that was more alkali tolerant. It used to be when I first started farming if I could raise three and a half, four ton an acre yield, I was satisfied. I’m raising three and half ton an acre now per cutting. It’s due to the seed. It’s due to my knowledge of what it takes to make it, a fertilizer program, a lot of things.

Interviewees noted how unpredictable markets for different crops also shaped agricultural practices in the basin. The crops in the basin have undergone decades of experimentation. Lloyd D. describes farming as, “…like going to the casino is what it is. Every year you never know. That’s why you do it again.”

Ralph U. remembers, “Everybody raised barley for a few years. Everybody raised malt barley. Then they all quit farming it. The whole country changed and went back to alfalfa and grass. Before that it was all grass. And so it changes with the people.” Ben and Karen Wilkes, ranchers on the north side of the river
in the Crowheart area, attribute the barley boom to Coors and Budweiser contracts for malt barley in the 1970s and 1980s.

Ralph U. shakes his head at the latest trends and again refers to his line of machinery:

See this combine sitting out here? Somebody down the road here about twenty miles had a little patch of oats they wanted to thresh. Nobody’s threshed oats up here for so long they don’t know what they need to do. ‘You got to cut it,’ I said. ‘We got to cut it? Then what?’ ‘You got to have some way to haul the grain off.’ ‘Oh? Where are we gonna put it?’ Nobody has raised any grain for ten years and the newcomers have no idea how to raise it. But they’re gonna raise some grain anyway.

Lloyd D. notes, “People have tried a lot of different crops. They’ve tried sunflowers and they’ve tried other things, and some people say they’re successful, but to do it year after year, make a cash crop out of it, make an industry out of it, they just haven’t been viable yet.” The proven crops are hay, sugar beets, and pinto beans but each farmer adapts his or her operation to what works best individually. As Lloyd D. says, “Can’t everybody raise beets, can’t everybody raise beans, can’t everybody raise hay. It’s just a combination of what suits you the best and what you’re set up to do.”

Lloyd D. owns Wyoming Hay Cubes and is one of the largest hay producers in the area, specializing in high quality hay cubes for equine consumption. His market is a nationwide, specialty market, which includes Kentucky Derby horse feed, “I’ve sent it to Miama, Florida. I’ve sent it to the University of West Virginia. I send three loads a month to Kentucky to the horse industry, to Iowa…Fort Collins…Montana…But that’s what I’m after. I’m after
people who would just as soon feed their horses as well as anybody else, first."

Lloyd raises hay that best meets the needs of this high end market:

I take pride in stands and rotations. We have good stands, we fertilize probably fifty pounds an acre more than they recommend...I don’t want any crop over about 16 percent protein, because the horse doesn’t like that. So what I do is I never cut any hay until it’s at least quarter bloom. When I do that I get a lot better yield, I mean I get tremendous yields doing that. And I pick my varieties, I have a couple choice varieties that I choose, that I think are better than anybody else’s for what I want to do. But my operation, like anyone else’s, I’m in a unique situation and this works for me.

Lloyd D. explains that beets “were gone for a period of time; they came back due to the demand...They struggled cost wise until they came up with Roundup Ready sugar beet seed and that has cut the amount of chemicals and labor tremendously. And the demand is coming back.” Sugar beets are processed in Worland or Lovell, Wyoming. The Worland Mill produces refined sugar, used in candy and confections. The industry fluctuates, says Lloyd D., “Now I understand that the market is back to being good for a year or two. It’s pretty tough and it takes lots of heat to process the beets. The price of oil and stuff is tough on them. And a lot of beets froze in the ground up in the Basin area this winter, they say 40 percent.”

Pinto beans is currently a good crop, though the market is constantly fluctuating. “Lots of pinto beans here,” Lloyd D. explains, “In fact they are the most viable crop as far as cash. I think they’re contracting near 30 dollars a hundredweight right now. And that varies from year to year. The last three or four years it’s been awful good. Crops have been awful good financially in the last
four or five years.” The market for beans is notoriously fickle. Lloyd describes the process of selling:

You and I both know that there are only two or three bean buyers in the United States...you’re at the mercy of the crop; you’re at the mercy of the inventory in the United States and Mexico. Mexico takes a lot of beans, and the price is volatile... They got a board down there at the Coop. You can get thirty dollars on the board for beans and all of a sudden they yank it off. They buyers got all the beans they want for now. They get another contract, here they come again. If they can get them for 20 then that’s what they’re gonna do, and that’s the way they play the game. See? That’s how they get in there.

Excess beans can be used as frozen beans or “friep beans at Taco Bell and places like that, so there are places to put it, but the farmer doesn’t get paid for it, they discount the price.” Lloyd D. sums up the experience as the “free enterprise system if you want to call it that.” Beans can be used to improve soils and sometimes farmers partner to produce both a good crop and improved soil. Lloyd partnered with a neighbor who was a bean farmer, and “I would let him have anywhere from 50 to 100 acres of my ground every year to put beans on. Mainly because when you come out of beans after two years, rotate it back to hay it’s a good crop. It’s a good way to clean up the ground and some other things. So he did that for me.”

Fluctuating markets and increasing expenses make agriculture increasingly difficult. The Director of the Wind River Environmental Quality Commission, Don Aragon, says of reservation agriculturalists:

We see a lot of people getting out of the farming and ranching business. They can’t afford it. What we used to call hobby ranchers can’t afford to stay in business, feed their cattle. I think a person with 50, 60 head of cattle or less can’t afford it. The
price of fuel, the price of equipment, the price of water, the…charges on water to irrigate their lands, all of these things have really changed their lifestyles.

Yet Lloyd D. describes farming as a hard life but a good life (Figure 3.3):

Let me tell you there are a very few things you can’t control in this world if you want to. Drought is one you can’t. But the ability to think and make a living is not. And I’ve never had trouble making a living and making money if I use my head and use my back and make it work, but you don’t do it by sitting around watching. And one of agriculture’s biggest problems today is that they want to farm for six months and they want to rest the other six, and you cannot do that. Agriculture is a business now. It used to be that when I first started I could stumble and the bank would probably carry me another year. Today, you owe any money and you stumble and you’re in deep trouble because of the cost of things. It’s big business…We’re not rich, but we’re sure not poor.

Figure 3.3 A farmer whose land borders the river stands in front of a bean field. Many refer to agriculture as a hard life, but worth it.
Cultural Geographies of Agriculture

There are noted differences between Native and Non-Native agricultural producers in Fremont County where only 206 of 1394 farms are operated by American Indians, and Indian operators earn an average of $31,539 for their products compared to $62,196 earned by other farms in the county (United States Department of Agriculture 2007). People’s perceive these differences and account for it in various ways.

Some basin residents attribute economic discrepancies to historical precedents. Rachel G. and Don A. both believe the problem stems from the federal government’s allotment policies in the early 20th century, which have led to fundamental problems with agricultural production on reservation lands. Under allotment policy, says Rachel G., tribal members “…were pushed to be farmers and so there was farming” but the results were not so straightforward. Don A. explains:

The Dawes Act [General Allotment Act] was the beginning of the demise of the reservations. Over time some people lost their lands due to unscrupulous or dishonest superintendents over here who… took the land out of trust and put it in fee. The people lost the lands because they had no concept of paying property tax; so they lost it...Some of the lands were just outright taken away from the Indians by the superintendent...he had the power to act on their behalf and just sold their land.

Many prime agricultural lands, even on the diminished part of the reservation, changed from Indian ownership to non-Indian ownership during that time.

The heirship dilemma, inherent in allotment policy, caused further problems. Don A. again explains:
Most of the time the allottee did not have a will. They may have had four or five children. Well, as they passed on, those four or five children received undivided shares in this land...maybe one or two of them passed on and left three or four kids. Well, that child comes along and inherits only the portion of their parent who had inherited. The fragments get smaller as you go on and two and three generations, pretty soon a person only owns a teaspoon full of land...In order to do anything with these lands, in some cases...you have to have 100% of the land owners in this undivided portion sign off on a lease...If you don't get 100% you can't do nothing with the land. And so the land lies there idle... and more people pass away and more and more heirs come on. And pretty soon these parcels of land are so fractionated that I've seen land listings of land holdings like 13/1000ths of an acre!

Kassel Weeks remembers his mom receiving checks for one cent, and Don A. estimates that it must “cost them pretty close to 250 dollars to process a one cent check with all the government paper work.” Don A. continues:

In some cases even the people who have been allotted the land can’t use it because they’re held by the same rule that you gotta have 100% give them permission, so they can’t even use it for homesites. So you may own a parcel of an undivided share but...the Bureau over here can’t tell you where your land is because they don’t know.

Reba T.’s father used to raise cattle and hay, but his land now has ten heirs, which isn’t as bad as many, she says, “Some of them have a hundred.” Regardless, their 80 acres is now idle land.

Land leasing is common on reservation lands. It is an easy way to make some money on lands if the owners cannot afford to farm, and avoids some of the heirship tangle. Rachel G. talks about the rising costs of farming:

It’s hard for a lot of people to buy and get loans for tractors. Big money!... and then there’s water costs up front...And of course our tribe has been paying water since these ditches were built whether they use it or not, so that's been a problem...It’s on our
land, they built it there, we pay for it. And so now, it's people barely making it.

As a result, “a lot of land is leased out to non-Indians,” Reba T. explains. Both Rachel G. and Sherry B. notice differences on leased land and tribal land. Sherry B. explains, “You’re driving down the road and you see somebody irrigating a field, growing a bunch of alfalfa, immediately you know that land doesn’t belong to an Indian. It’s a non-Indian… you drive down the road and see all those plants out there, beets, whatever, it’s pretty much a given that it’s non-Native land, not Arapaho” and Rachel G. says, “You see a lot of the land leased. If it is in crops, it’s leased land. Somebody else is growing the corn. You see a lot of corn and you see a lot of sugar beets now.”

Many people attribute the lack of agriculture to poor irrigation infrastructure on Indian lands. Kassel W. believes:

The water starved nutrient rich soil on tribal lands are idle because of the poorly designed irrigation systems that was done by the BIA in the early history of this Reservation. The only progress for farming and ranching is on non-Indian lands on the Reservation and they have the best irrigation and the outstanding river bottom lands to grow crops and bring in the huge amount of money for their families.

Berthenia Crocker says:

I know for sure that the BIA irrigation system, the whole infrastructure, is in a state of collapse and they can’t even take the water out of the river anymore in some places and distribute it. And that’s just a matter of the federal investment over that period of time. It’s maybe one tenth of the investment on the other side of the river. I expect if you contrast those two areas you probably see big differences.
Perceptions of Agriculture: Should it Exist in the Wind River Basin?

Agriculture in Fremont County comprises less than 1.3% of the GDP and many people think the federal investment in agriculture, and the environmental impacts are not worth the economic gains in the Wind River Basin. Berthenia C. flat out says, “I think this is the wrong place to try to grow crops” and several—mainly conservation interests—in the Basin agree. Richard B. says:

I’m hoping that people will realize that water has to be managed more efficiently and that leaving water in the river is probably more important than taking water out of the river. When you really look at agriculture in the Wind River Basin, agriculture is a non-paying proposition. You can’t justify the amount of water that they’re using to put on the land to grow what they’re growing. You can’t justify that. It’s not economical…I think people are starting to realize that the philosophy the tribes have of water, and using water, and the importance of water to all life is a much better viewpoint than looking at it from one or two uses, particularly agricultural uses.

Dave Skates notes, “They’re putting all that water on the landscape and ruining a lot of those soils out there… for alfalfa?” Geoff O’Gara expresses a similar point:

I can’t think that what’s done with the water really contributes that much to the economy. I mean it does contribute, but it’s a subsidy like everything else. It’s not a pure economic engine itself without the feds underwriting all this… and people complain about all the tribal federal benefits. It’s amazing people can do that with a straight face when you look at the benefits that non-Indians have gotten from the development of this water. And again, it isn’t that big an economic engine. It gets exaggerated.

Some tribal members disagree, and believe irrigation infrastructure and agriculture should be expanded on the reservation. “Maybe in the future we’ll build a dam up there that’s just for the use of the people here in these
communities instead of for the use of it down in Boysen, and that we can create more farming for our tribe,” Rachel G. reflects and Sherry B. holds a similar view, “Irrigation wouldn’t be an answer to all of our economic problems, but it would help stimulate a certain part of the economy here.”

Lloyd D. takes pride in the success of the Riverton Project, “This project has been more than a success” he explains and “we raise excellent crops” but he does recognize cultural differences “[the Riverton Project] is part of a withdrawn area from the reservation and there are some hard feelings between here and there.”

Perceptions of Culturally Significant Plants

Plants are one component of a larger sense of place among Eastern Shoshone and Northern Arapaho people. Various species support Eastern Shoshone and Northern Arapaho ceremonial life, provide food and medicine for tribal members, and as importantly, maintain their historical significance even when they are not currently used (Figure 3.4). Plants are part of the symbolic associations that create sense of place; they “swim within its reach and move it on its course” (Basso 1996, 145). In the process of harvesting, using and remembering, plants bind communities together through their enduring historical traditions. The Wind River Basin is inseparable from its peoples where generation to generation “their surroundings live in them” (146).
Language is the root of cultural perception, the avenue through which relationships are expressed and, arguably, formed. The Shoshone and Arapaho languages are particularly descriptive; for example, the Arapaho word for wild currant is áa:sesónó, or “fuzzy little things”, horsetail is ceniiθliise’ís “it goes inside” representing its jointed structure, and the Shoshone word for the wetland sweetgrass is bah, soe·ree”p “water, wild hay”. Names often convey cultural-ecological relationships. For example, the Shoshone word for wild licorice, dah·gee·poe, nah·nah·tsoo translates as “kidney, medicine” and the Comanche are called yampai after the word for carrot yahm·p because “when they left to go to Oklahoma, when they left our bands here that’s what they were eating,” Reba Teran, Shoshone language consultant, explains. Other words, such as the Arapaho word for alfalfa, naa:sná-kosee: “two cuttings” demonstrate the way
language adapts alongside environmental change, accommodating new words with concepts.

Table 3.1 and Table 3.2 provide indigenous names for riparian plants that are still valued by the Shoshone and Arapaho people.

Table 3.1 Shoshone plant names listed by common name, Shoshone name, and direct English translation when applicable.

<table>
<thead>
<tr>
<th><strong>Plant</strong></th>
<th><strong>Shoshone Name</strong></th>
<th><strong>English Translation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>boo·hee, soe·reeponder</td>
<td>green, hay</td>
</tr>
<tr>
<td>Buffaloberry spp.</td>
<td>ayⁿ·koe·m</td>
<td></td>
</tr>
<tr>
<td>Chokecherry</td>
<td>doe·rahmponder</td>
<td></td>
</tr>
<tr>
<td>Cottonwood</td>
<td>soe·hoe·v</td>
<td></td>
</tr>
<tr>
<td>Currant spp.</td>
<td>hoe·ah, voe·goe·mp</td>
<td></td>
</tr>
<tr>
<td>Currant (Wax/Squaw)</td>
<td>duhⁿ·gweeponder</td>
<td></td>
</tr>
<tr>
<td>Gooseberry spp.</td>
<td>way·shee, voe·goe·mp</td>
<td></td>
</tr>
<tr>
<td>June berry</td>
<td>duh·rahm</td>
<td></td>
</tr>
<tr>
<td>Licorice (Wild)</td>
<td>dah·gee·poe, nah·nah·tsoo</td>
<td>kidney, medicine</td>
</tr>
<tr>
<td>Field Mint</td>
<td>boo·hee, gwah·rahⁿ</td>
<td>plant, odor</td>
</tr>
<tr>
<td>Pinto Beans</td>
<td>bee·hoo·dah</td>
<td></td>
</tr>
<tr>
<td>Rabbit Brush</td>
<td>dah·see·yah</td>
<td></td>
</tr>
<tr>
<td>Rose (Prickly Wild)</td>
<td>ayⁿ·gah, toe·n·zee·yah</td>
<td>red, flower</td>
</tr>
<tr>
<td>Sagebrush spp.</td>
<td>boe·hoe·v</td>
<td></td>
</tr>
<tr>
<td>Scouring Rush</td>
<td>goo·kee·toyponder</td>
<td></td>
</tr>
<tr>
<td>Serviceberry</td>
<td>duhⁿ·gweeponder</td>
<td></td>
</tr>
<tr>
<td>Spring Beauty</td>
<td>soe·goe, zee·nah</td>
<td>earth, potato</td>
</tr>
<tr>
<td>Sweet Grass</td>
<td>bah, soe·reeponder</td>
<td>water, wild hay</td>
</tr>
<tr>
<td>Sweet Sage</td>
<td>bah·v·hoe·v</td>
<td></td>
</tr>
<tr>
<td>Tobacco</td>
<td>bahⁿ·h⁰⁰</td>
<td></td>
</tr>
<tr>
<td>Water Birch</td>
<td>day·nuh·ti·gwah</td>
<td>small, hit</td>
</tr>
<tr>
<td>Weed</td>
<td>yoo, soe·reeponder</td>
<td>plain, hay</td>
</tr>
<tr>
<td>Wild Carrots</td>
<td>yahm·p</td>
<td></td>
</tr>
<tr>
<td>Wild Onion</td>
<td>guhⁿk</td>
<td></td>
</tr>
<tr>
<td>Wild Potato</td>
<td>soe·goe, zee·nah</td>
<td>dirt, potato</td>
</tr>
<tr>
<td>Wild Raspberries</td>
<td>doy·yah, ayⁿ·gah,</td>
<td>mountain,</td>
</tr>
<tr>
<td></td>
<td>poe·goe·mp</td>
<td>red berry</td>
</tr>
<tr>
<td>Wild Rose</td>
<td>ayⁿ·gah, doe·n·zee·yah</td>
<td>red, rose</td>
</tr>
<tr>
<td>Wild Strawberry</td>
<td>doy·yah, ayⁿ·gah·pah·dyⁿk</td>
<td>mountain,</td>
</tr>
</tbody>
</table>
Table 3.2 Arapaho plant names listed by common name, Arapaho name, and direct English translation when applicable.

<table>
<thead>
<tr>
<th>English Name</th>
<th>Arapaho Name</th>
<th>Direct Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>naa:sná-kosee:</td>
<td>two-cuttings</td>
</tr>
<tr>
<td>Buffaloberry</td>
<td>hó:xe:hibino</td>
<td>bull-male</td>
</tr>
<tr>
<td>Chokecherry</td>
<td>bee:non-áw aw wa</td>
<td>berry-bush</td>
</tr>
<tr>
<td>Cottonwood</td>
<td>hohó:t</td>
<td>tree</td>
</tr>
<tr>
<td>Currant (wild)</td>
<td>áa:sesóno</td>
<td>fuzzy little things</td>
</tr>
<tr>
<td>Dogwood</td>
<td>tháa:kon-nevino</td>
<td>ghost berries</td>
</tr>
<tr>
<td>Gooseberry</td>
<td>toxu’-u:wuno’</td>
<td>red ropy bush</td>
</tr>
<tr>
<td>Horsetail</td>
<td>ceniiθiise’</td>
<td>sharp berries</td>
</tr>
<tr>
<td>Licorice root</td>
<td>woníseine:hi:s</td>
<td>it goes inside “joint grass”</td>
</tr>
<tr>
<td>Mint</td>
<td>wá ah non</td>
<td>may mean “it goes after women” with barbs</td>
</tr>
<tr>
<td>Mountain or river birch</td>
<td>ní:yo’óeno</td>
<td></td>
</tr>
<tr>
<td>Onion</td>
<td>xouucen</td>
<td></td>
</tr>
<tr>
<td>Peppermint</td>
<td>wóho:nó’</td>
<td></td>
</tr>
<tr>
<td>Rush (Juncus balticus)</td>
<td>hotohine</td>
<td></td>
</tr>
<tr>
<td>Rose bush</td>
<td>yá:ená:s</td>
<td>sharp thorns</td>
</tr>
<tr>
<td>Skunkbrush</td>
<td>bee’éí’i</td>
<td></td>
</tr>
<tr>
<td>Strawberry</td>
<td>hite:hibino’</td>
<td>heart-berries</td>
</tr>
<tr>
<td>Sweetgrass</td>
<td>ní’óxu’</td>
<td>good-grass</td>
</tr>
<tr>
<td>Wild rose</td>
<td>wáhXu:-ya:no</td>
<td>elk-berries</td>
</tr>
<tr>
<td>Willow</td>
<td>yó:koxuu</td>
<td></td>
</tr>
</tbody>
</table>

(from Cowell 2005)

Few tribal members still speak their native languages, but many are familiar with at least a few plant uses and words.
All interviewees were asked to name common plants in the area, and then to name plants that were of value to them. Many tribal members discussed culturally significant plants. Though they were never specifically asked about uses (in order to respect culturally sensitive information) some interviewees offered information on how the plants were utilized. Their responses can be separated into three broad categories: berry bushes; riparian trees and shrubs; and forbs and wetland plants.

**Berry Bushes:** Berries have long been central to Arapaho and Shoshone cultures as a food supply, but gathering is also a part of family and community life. Sherry B. remembers berry picking as central to her family:

> My earliest memories of my family, my parents, my uncles and my aunts and my grandma, everybody would go down to the river and there was a lot of currants and a lot of bullberries [also called buffalo berries] down there and so we were always picking berries all the time and taking them home to my grandma. And she'd always cook us frybread and gravy.

Now, she notes:

> Back when I was a kid, seems like there used to be a lot of bullberry trees and there was just a ton of them, and now it seems like I hardly see them around anymore. And I don't know if it's because these Russian olives are taking all the water which I'm assuming might be part of the reason, but I'm not entirely positive...those olive trees. Man they just seem to be growing everywhere down there.

Iva Redman continues to pick berries with her family, and recalls picking currents along a Wind River tributary, “I think we surprised a bear that one time up there. He was in there and we were in there (laughter) and then he poked his head up.” Someone noticed the bear and warned Iva R. and her family, “and we
looked up and looked around and we didn’t see him. We…said, ‘There’s no bear,’ and then he came running out and we saw each other and he took off the other way. Chee! We were in the same bush!”

Reba T. tells a story she uses to warn her students about picking and eating any old berry:

Well we took the kids out and this one little guy, he’s a little rebel about five years old six maybe, and he just grabbed this berry and ate it. And she [the other instructor] told him ‘you can’t do that!’ And so she told him this story about this white berry that’s in our mountains. The bears eat it, and it’s to clean out their insides or something. They do it naturally. They like to eat it every now and then. What it does is make their butts itch, there inside. So there they are riding around on their butt scratching and as soon as he [the student] heard that he started spitting it out… they call it \textit{gwee·dah·wuh·pee·hahn·gay·d}, oh it’s funny, it refers to the bear’s itchy butt. So, you have to know what you’re eating.

All tribal members interviewed noticed an overall decline in riparian berry bushes, with one exception: Reba T. notices an increase in bullberries but a decline in all other berry bushes. All other Arapaho and Shoshone interviewees, regardless of their location, report decline in berry bushes. Elder Joyce Duran, from Arapahoe, notes, “The berries are harder to get now. Remember those red berries? Those bullberries? You used to see them all the time and now you don’t. Currants used to be everywhere and they aren’t anywhere now. Wild rosebushes used to grow along the fence, but you don’t see them anymore. You barely see them anymore.” Likewise, John W., from Crowheart, says, “The gooseberries, currants, chokecherries, they’ve been devastated. I don’t know what’s happening
to all of it...Where they can find it, people still gather berries. Chokecherries are a big commodity around here."

Iva R. remembers that, “Where my grandma used to pick her chokecherries and bullberries, that’s not there anymore.” Reba T. says, “From what I remember there used to be a lot more berries around here, especially chokecherries. In our family pasture we had lots of chokecherry trees, serviceberries, currants and gooseberries.” And Jolene C. says, “I’ve heard from some that the berry bushes have really declined. Especially the chokecherries. Many are concerned about the mosquito spraying during the summer and how this ‘poisons’ the berries.”

**Riparian Trees and Shrubs:** Cottonwoods and willows, and subsequently riparian areas, maintain a central role in tribal ceremonial life (Figure 3.5). Rachel G. emphasizes, “The cottonwood is very important to our tribe. It’s used in a lot of our cultural ceremonies. And the red willow and some of the other willows are also very important to us.”

Reba T. considers cottonwood trees to be the single most important plant to the Shoshone tribe. She outlines three uses, one current and the others historical, “Cottonwood is *soe-hoe-v*... And the reason why that’s so valuable is because in our Sundance ceremony, the center pole is a cottonwood. Around it, the supporting poles are all cottonwood.” Historically, “we also made saddles from cottonwood because it’s a real soft wood. Once it’s dried up it’s light and soft.” Shoshones would line the cottonwood saddle with rawhide, which provides
“...the strength of the saddle, because once you dry it, it’s just tough as ever, almost like fiberglass or plastic.” The third use was “to feed the horses, like the inner bark when there was no food.” Reba T. notes that “people say our horses were real taken care of.” Richard B. also considers cottonwood a very important plant, adding that (in addition to Sundance) “…they use it for peyote meetings. They use that smaller cottonwood for the fires...they've used those for years and years and years. They use them a lot.”

“Red willow” (which refers to water birch, *Betula occidentalis*) is also used ceremonially. Kassel W. explains:

The Eastern Shoshone and Northern Arapaho Tribes each have a religious ritual that they perform each year. This is the Sundance. Many tribal members participate in this ceremony. The family members camp on the Sundance ground and they, traditionally, use the red willow that grows along the river bottoms to build shade huts. Many red willows are cut each year. The red willow is also used for bows for weapons and poles for fishing and for sweathouse ceremonies to move hot rocks with a forked willow branch.

Additionally, Reba T. notes that historically, “we made our camps from that. They had the round little leaves, maroon bark with the little white things. Those were special for camps and they also made little game toys because it was easy to peel and it was a little stronger and thicker than willow.” “Some of the other willows are also very important to us,” explains Rachel G. and Iva R. references the value of “the white and the red and the yellow.” Historically, Reba T. says, “We made a lot of things from it. The willow could stop a headache--the bark of it—if you chewed the bark of a certain red willow.”
Many tribal members are concerned with declines in cottonwoods and willows. John W. worries that “The red willow—the birch—that we use for a lot of things, it’s really disappearing. It’s used so much for ceremonies, and now it’s hard to find.” Iva R. notices overall willow decline, “Those are disappearing, all kinds.”

Referring to plains cottonwoods, Iva R. says:

Can’t find them anymore. They’re dying. They’re dying. They’re seeing that the ones that everybody’s allergic to are coming up, those narrowleaf instead of the wide. They [tribal members] prefer the big ones [plains cottonwood] because it doesn’t give off that… pollen that’s on the narrowleaf. It kind of bothers them. They prefer the big but they’re starting to see the narrowleaf taking over.

Sherry B. recalls the area around her childhood swimming hole, which was called “One Tree” after an enormous plains cottonwood, and recalls, “It does seem like they’re not as plentiful as they used to be when I was a kid…I never realized it, but now that I think about it, I don’t think there’s as many [plains cottonwoods] as there used to be when I was growing up.” She notices narrowleaf cottonwood, “but no great big cottonwoods, just those narrowleaf,” at the swimming hole. Jolene C. sees larger trees, but notes the lack of “new growth of cottonwoods. I don’t think we see a whole lot of that.” While the U.S. Fish and Wildlife Service does not focus on cultural uses of plants, it does work to maintain fish and wildlife habitat. One of the service’s largest concerns in riparian areas is proliferation of invasive species and “the lack of cottonwood regeneration…you can see it all over, old decadent trees that aren’t regenerating,” Pat Hnilicka says, “Especially
the lower part between Riverton and Boysen, you just have these big old cottonwoods and nothing underneath.”

Kassel W. notices “the willows and the brushes that used to be green and lush are dying. There are huge areas…turning into dry dead clumps of brushes and dead trees. Whether this is a tree disease that is spreading…or irrigation practices or the fertilizing of the land, I am alarmed.” Rachel G. observes, “…the riparian areas where plants used to grow, that’s disappearing, so that’s real important for us to have those trees and plants growing again.”
Forbs and Wetland Plants: Tribal members certainly rely less and less on gathering local food and medicine in riparian areas, but some species are still highly valued and regularly harvested, while others are gathered more rarely.

Don A. explains:

…when we were very young, we had Indian medicine men. They actually used to use herbs, plants and stuff in treating the various ailments. And today that’s a lost science because a lot of these so called Indian doctors never passed on the knowledge to anyone younger...in the White world, or the non-Indian world, you have people that are reverends, pastors, and spiritual leaders and you also have physicians that are doctors. Well, the old Indians had the same thing and they used to use the various kinds of herbs and plants in treating things... The wild rose bush root was always considered a good one for stomach ailments. But we don’t have anybody to really guide us now on what plants you use for different things and so I think there has also been a drastic change in the twenty years I’ve been working in this position here in our culture from that point of view.

Some tribal members still gather plants for food, medicine, and ceremonial uses. Rachel G. writes:

…sage is another plant that grows out there and very common to a lot of northern tribes. We all use that. Sweetgrass is another one. It grows here but it grows very short. It isn’t a really long plant but we used to pick it a long time ago, I know that it grew along the rivers. We have the wild carrots, the wild onions that we used to also pick when we were children and we know they’re out there. I don’t know that anybody picks them anymore.

Reba T. remembers eating gathered food as a child:

…we had to fend for ourselves. We gathered berries, we ate fish, my brothers hunted for us. I remember being so hungry. I can’t remember what was going on, but I was digging up wild onions and eating those. We called that guh’k … and licorice
was *dah·gee·poe, nah·nah·tsoo* meaning *dah·gee·poe* is our word for kidney and *nah·nah·tsoo* is medicine. That was our kidney medicine. Then we have *goo·kee·toy·p* that’s scouring rush. We used that as a shining agent because you burn it and the ashes become like comet, or abrasive, and they used it in the child’s mouth for thrush. They would rub it and rub that stuff off.

Iva R. remembers collecting plants along the river with her grandma:

…we went to go look for this one root, they called it yellow root and it helps with the mouth sores. It kind of burns, but what you do is it grows underneath [river overhangs]. She told us how to harvest it. She said, ‘it has a flower,’ she said, ‘but you can’t see that flower to know where it’s at, because these cows love to eat the flowers. And then look at the grass, it’s all the same size,’ she said, ‘so now you have to get down there and feel for it and pull it up and then look and break them to see if that’s what it is.’ So it’s harder to find. And then you talk about these older ones [elders] are coming up and asking Mike if he knows where to get it, that same root, they can’t find it anymore or they don’t know how to get it. I mean that water’s really cold.

Iva R.’s grandmother used to take a wagon downstream along the Wind River toward Thermopolis to gather plants each summer, “They’d have to go and camp. My grandma remembered when they were on the wagon and they would have to go up and down the river to get what they needed.” Iva R. explains that many of the common household medicines grow along the river, but others grew at different elevations in more specialized habitats:

When they would travel over to Thermopolis, they would stop up on the mountains and get what they needed there, Birdseye Pass. She said they’d go over that way. She said they’d go through the canyon going over there. It would take them about a week, she said [to get to Thermopolis], and then there was more medicine up there that they had to get, so they’d leave Thermopolis come through Birdseye and come back down.

Reba T. talks about valuable species that grow in the area:
Wild rose, that was *doe·n·zee·yah, ay·gah, doe·n·zee·yah* for the red, red rose. But *doe·n·zee·yah* is important because it’s sacred to us. For every Shoshone, when you die, they put a stalk of that *doe·n·zee·yah*, wild rose, to keep your spirit from wandering around. They do that for everybody. That’s the importance of wild rose.

Rabbitbrush and sweet sage are not specifically riparian plants, but do grow in Wind River bottomlands:

We used rabbitbrush *dah·see·yah* for VD. Sweet sage was used spiritually, that’s *bah·v·hoe·v*. It was used for spiritual smudging but also you could boil it and drink it and stop your cold or make it shorter. You could boil it if you had fluid in your lungs, boil that and make a poultice, put it in a rag and put it on your chest. I did that one year I was in Tacoma. I was sick for two weeks with a real bad cold. I started drinking the tea, but it still wasn’t enough because it was in my lungs, so I made a poultice and put it in my lungs. I would get up, stagger to the microwave, zap it, get it hot again, put it on there. I think I did that all day long by the morning I was well. So I do it right away nowadays. I don’t wait around.

Some plants are used to feed the spirits, “…dried meat, water, the berry stuff, and probably spring beauty, potatoes, stuff like that,” Reba T. explains, “You would offer your traditional foods to the spirits and tobacco because tobacco was real important in our spiritual ways too.” Reba T. describes the way her brother gathers tobacco for offerings:

He would walk around and he was starting to hear the spirits talking to him and they would tell him what to pick and how and what to mix, and so his mix, Indian tobacco, is really good stuff. And when you offer to the spirits, you offer tobacco to them… Sweet grass is the same. We call that *bah, soe·ree*p meaning water hay… Everything was sacred to us, all the foods. You did your ceremonies, you did your traditional food offerings to your spirit helpers… and it’s still done today.
Declines in Culturally Significant Vegetation: Interviewees see culturally significant vegetation declining overall. Rachel Grant explains that “tribal members do not attribute the loss of these species to any one cause” and believe that pesticide application, dewatering and damming, invasive species, grazing and over harvesting are all suspected causes. Iva R. summarizes:

It’s disappearing. Like when my grandma would go and get things that she needed, she’d take me and Mike out and she’d say ‘okay we'll go look for this type of medicine’ and it would be gone. And then Mike’s noticing the same thing, where his dad used to get medicine, up next to the streams and the mountains there, it’s gone. So you either have to go further up or find a whole new place now where it grows.

Similarly, Rachel G. remembers:

Like I said, there used to be little wild carrots out there and wild onions that we used to go pick, but then they started spraying the ditches so it eradicated a lot of the little plant life, the wild onion and wild carrot that used to grow there and even a wild potato. There used to be a wild potato, real small. Everything was real small, little tiny carrots, and little tiny onions, but they were edible. And then they started spraying all the ditches and maybe you can find them up in the mountains where they haven’t been sprayed or anything, mountain springs and mountain streams, but not down this way.

Like Rachel G., Don A. suspects spraying has negatively influenced certain areas:

…you know, when you spray the knapweed, you don’t only spray the knapweed. It broadcasts all over…I think it’s something we need to evaluate…some kind of long term studies to go back in and look at the impacts of chemicals to control weeds. I can recall as a young person the spray trucks driving up and down the ditch banks with these big booms down…and I think those spray activities really impacted a lot of the current plants and I think it has changed some things.
Iva R. suspects changes happened “after they built that Diversion Dam,” and attributes the decline of many species to lack of water and floods. “No water,” she says, “She [Iva R.’s grandmother] remembered the floods that would come out. When it would flood…they couldn’t get to their house. She remembered when the flood would come up right to her door.” Iva R. believes these floods played a role in maintaining species distributions in riparian areas.

U.S. Fish and Game staff also blame changes in the flood regime and overall dewatering to particularly cottonwood decline, “I’m sure that the riparian areas were much greater in width as you went down the system prior to those two structures [Diversion Dam and Bull Lake Dam]… That altered the entire system.” Richard B. says, “[dewatering] surely has had an effect on the vegetative cover on the riverbottoms.”

Again, Dave S. (U.S. Fish and Wildlife) explains:

I don’t know what the flows are today in Riverton, but I’d say they’re probably less than 100 cfs. If we didn’t have irrigation they would probably be flowing 700, 800 cfs right now, maybe even higher…The problem is we don’t have an annual flooding event anymore. You’ve taken the flood out of the picture, so you don’t have those seasonal floods. Even on a drought year you would have flows greater than you would have on an average year now with all the damming and holding back those peaking flows. You don’t have those flushing flows through the system to maintain certainly the river system. You’ve got a lot more sediment in the system now. It just stays in the system because it’s not flushed through. That has a great impact on fish production, but also for your riparian plants and vegetation. You don’t have the plants that you used to have. You’ve got a lot more alteration in the last 50 years by man and it still is occurring, so you still have a lot of head cutting and down cutting of the river. In a lot of areas those cottonwood galleries are sitting pretty high now…the regeneration of younger plants just simply isn’t going to occur anymore in certain areas.
Pat H. agrees, “Just the lack of seasonal flooding and how the cottonwood regeneration is so tied to that, between that and the livestock hitting it...you know, you look at that and you think ‘man a lot of these cottonwoods are gonna be gone.’ Once these big trees die there won’t be much there returning.”

The proliferation of Russian olive concerns Rachel G., Reba T., Sherry B., Richard B. and the U.S. Fish and Wildlife Service, which reports areas where “it’s so thick you can’t even walk through it.” Rachel G. recalls:

They were brought into our reservation. Probably, when I was growing up, younger, probably say the forties or fifties, maybe the fifties or sixties even, they had the people from the University of Wyoming organization that came out here, what’s it called now, the Extension Service. They brought the Russian olive and it has grown to be a nuisance here, very much so. And it’s taken over some of our ditches and around our rivers and where our water sources are. And it’s really undesirable... We used to have a lot of willows...our white willow and our red willow plus our berries. It’s taken over...It’s pushed them out... I would like to see it eradicated.

Jolene C. says, “I don’t even like the way they smell. I think it’s odd they were sold as an ornament plant through the conservation district, and now they’re thought of as a nuisance.” Reba T. calls them “the ugly silver trees. I like the smell of them they smell good—perfume—but you can’t play in them. As children we tried to play in them. They got thorns and we didn’t like them because of that, and they’re a weed and they go crazy. We’re getting too many around here. They need to start cutting them or doing something with them.” Sherry B. believes that “all the vegetation down there has just gotten overgrown... There’s Russian olive
trees everywhere. To me it seems like it just chokes off a lot of the other vegetation.”

Grazing “has taken a huge toll,” says Scott Roth, also of the U.S. Fish and Wildlife Service. “If they [cottonwoods] were regenerating, they’re snipped off just as soon as they started coming up. There’s a lot of overgrazing taking place along the river corridor and that’s probably one of the huge problems with that whole system.” Pat H. compares areas of the Big Wind River to the Little Wind River near Fort Washakie that burned several years ago, “and you look at that regeneration and I mean it’s thick, you can’t walk through a lot of that” the area is so thick with young cottonwoods, “but there’s no cattle grazing down in there either.” Along the Big Wind “the overgrazing by cattle along the river corridor is keeping the little chutes from establishing.” Kassel W. believes grazing also affects the berry bushes:

My sister picks berries each year and she has mentioned that the livestock that graze on forest lands have trampled some of the berries. These berries grow along rivers, creeks, brooks and wetlands. Cattle and horses love these wet areas because of the shade of the trees. The water is a major source for drinking and the area is trampled beyond recognition of green growth. We have noticed that the berries are dying and drying earlier than usual.

Iva Redman (as mentioned above) believes cattle feed on culturally valuable forbs.

Over harvest, particularly of water birch (“red willow”) is thought to be a cause of its decline. “People are probably using them more,” says Iva R., “Now you see more sweat lodges and so they’re thinking that they’re being harvested
more than they normally would have been. That’s what they’re thinking. There are a lot more sweat lodges and for a large one you use up to maybe about thirty [large “red willow” branches].” Jolene C. notices, “Another plant we don’t see a lot of—the red willow they call it—is the water birch, it’s been used so much that it’s a dying breed around here.” Kassel W. is worried that “This leads to river bank erosion.” He notes this as an important enough concern that, “Whenever we have public meetings on the environment, we do mention the use of red willows and other variety of plants and trees, and how to lessen the human activities that have major impacts on the river systems and the ecosystems.”

Rachel G. feels the tribes need to act and manage riparian vegetation more effectively, “We want to replant trees, riparian areas; we want to make sure that they’re growing again. Like I said, the one tree that’s really important to use is the cottonwood tree and…the riparian areas where plants used to grow, that’s disappearing, so it’s real important for us to have those trees and plants growing again.” When Sherry B. thinks about the future of the next generation she says:

I think it would be nice for them if it [the reservation’s riparian areas] had a lot of grass and no Russian olive trees or Russian knapweed, and none of these invasive species, just natural vegetation. I’d like them to experience something similar to my childhood when we used to pick berries…just going and swimming and picking berries and taking them home to say ‘hey can you make me some berry gravy and some fry bread?’ I think they would just love that.

Perceptions of Weeds

‘Weed’ is a relative term. When responding to an interview questions asking interviewees to identify plants ‘that are of value’ and plants ‘that are not of
value’ Kassel W. reflects, “What plants have value and what plants have no value does pose an intriguing question. I was taught by my elders that all the living world is alive and important to our survival. Our very survival is tied to, and into, the green world. [All of] the plants on this Earth live side by side. If plants, like some humans, couldn't live side by side in harmony, then the whole world would be a dead place.” Similarly, Reba T. says, “Sometimes when I’d ask my Aunt Roberta ‘what was that used for?’ she would say that was Mother Nature’s beauty.”

Regardless, several species are unequivocally recognized as weeds. Kassel W. defines invasive species as “the kind that can’t live side by side with other native plants. These kinds of plants may kill and destroy the native plant habitats.” U.S. Fish and Game staff named salt cedar, Russian olive and knapweed as their greatest concerns in riparian areas. Lars Baker, head of Fremont County Weed and Pest, lists thistle, leafy spurge and Russian knapweed as the three worst weeds with respect to acreage; leafy spurge, thistle and knapweed by economic impact. Lloyd D. lists knapweed, white top and Canadian thistle as the three worst weeds on his land. Management is a consistent part of farming and each plant has its own manner of spread:

[A weed] goes in the water, it goes in the wind. All of our winds are from the west, the northwest. Canadian thistle moves in the wind worse than anything because it fuzzes up and blows. And the problem is that if your neighbor doesn’t control his I have trouble controlling mine...I use gated pipe on a lot of fields to irrigate and you can see where that gated pipe is and you can see where those weeds come in on the water. Above the pipe is clean and the first hundred feet below it show signs of weeds and that has to be from the water.
Lars B. believes most weeds are a result of farming activity, and “the seed sack” is the method of spread. While the first weed law of 1928 seemed beneficial, he emphasizes that it was in fact detrimental because it only required 97 percent pure seed, problematic because 99 percent was possible. “At that time,” he explains, “certified seed contained over 500 varieties of problem seeds including yellow star thistle, 24 geneses of Carderia—white top, hoary cress” and others.

Knapweed, and particularly Russian knapweed was the most commonly identified weed among interviewees. Ben W. says, “Knapweed, of course, is everywhere,” and Sherry B. notices its proliferation, “And then there’s that Russian knapweed. It’s just growing rampantly, that’s all of our land right there, and it’s just growing rampantly everywhere.” Richard B. reports that, “knapweed has really taken over some of our river bottoms. You’ve probably noticed it. I don’t remember that when I was a kid growing up. It might have been there, but it wasn’t anything like it is now.” Lars B. describes knapweed as an exceptional distributor of seed. He was involved in an experiment where “we took a six inch square cow pat” from a cow that had eaten knapweed in the winter, allowed the seeds it contained to germinate “and found 230 knapweed seedlings.”

There may not be one single historical source of Russian knapweed. Alan B. believes it came into the area during the late 1800s. He suspects that, “Irrigation and farming on the reservation were used to domesticate Indians and I’m sure alfalfa was one of the main components in that process. The problem
was that there wasn’t adequate management. The alfalfa disappeared and knapweed stayed.” He also believes it was introduced when the Riverton Valley project and LeClair irrigation projects began. Lloyd D. notes, “Russian knapweed, it’s been here as long as I’ve been here,” but Ralph U. remembers when it arrived in Crowheart, “Knapweed, it started up the creek up here on Crow Creek. A guy imported some seed oats and he brought it in.” Russian knapweed is now referred to locally as ‘Crow Creek alfalfa’. “You bet,” says Ralph, “well he sold seed oats to everybody in the county. He sold good oats. ‘I’ll just sell you some seed. Those little black specks in there, don’t worry about them!’” Ralph laughs, “Yeah, no problem… Oh it spread fast, because when you start selling seed oats, why you move it 20, 30, 40, 50 miles in one year.” Referring to the name ‘Crow Creek Alfalfa,’ Kathy W. says, “Yes, that’s a nickname from it. There’s so much of it up there. Crow Creek’s loaded with it.” Lars B references “Arapaho alfalfa” as a second colloquial name.

Ralph U. remembers the origin of another patch of knapweed on his land:

There was one patch of knapweed up here at the west end of our place. Kind of a little swale. And just looking at the lay of the land and everything I imagine it was the camp when they were building the irrigation canals…that’s where they kept their horses, just a little swale up here, and there’s knapweed there. Well, they probably brought the hay from Trout Creek. And that knapweed is still there.

Ralph U. believes, “they just drove wherever was easiest… ‘here’s a good place to camp while we’re building this canal down through here,’ pasture your horses here, picket them, or whatever they did, feed them hay. And that helped scatter noxious weeds.”
Canada thistle is another species identified by agriculturalists in the Basin, notable because, Lars B. says, “Canada thistle is the number one weed in the world,” and he estimates 60,000 acres infested in Fremont County. Lars B. believes it entered the U.S. from Europe with General Burgoyne during the Revolutionary War in livestock feed. By 1895 the Wyoming legislature had already implemented a Russian and Canada thistle Control Act. Ralph U. believes, “Canada thistle isn’t as bad now as it was ten years ago,” perhaps because, as Baker notes, “It responds to Roundup, so if you’ve got thistle it’s your own fault. You don’t see the problem you used to see in Midvale. Roundup has made a huge difference in our ability to farm and be productive.”

Interviewees also reference white top, bindweed, rosinweed, sowthistle, kosha, cocklebur, houndstongue and leafy spurge as problems. “We seem to have a lot of rosinweed up here that I don’t think was as bad when we got here as it is now,” says Ben W. In a survey of culturally significant plants Reba T. took a group of students into the mountains and tracked bindweed, “When we went up there we found it at 6330 feet up in the mountains because we had GPS units and we were keeping track.” She is concerned about its impact on culturally significant plants. Ralph U. remembers, “We had sowthistle ten years ago. Boy they were just sure sowthistle was gonna take over everything, and they all died out” unlike knapweed, he notes, and “white top, that little white top been here ever since when I was a kid. And I guess it is a little worse now, well I know it is, because back then there were just a few small patches and now there’s a few small plants all over.” Lars B. is very concerned with leafy spurge, which appears
on the home page of the Fremont County Weed and Pest website. Lars B. believes it appeared in 1952 with a load of hay and was quickly established. He explains that leafy spurge is thought to have appeared in the United States in approximately 1860. “Smooth brome grass is the culprit,” he says, explaining that the first four records on the plant come from land grant colleges that split a sack imported from the Soviet Union. Lars B. is additionally concerned about ornamentals that could become problematic, such as Japanese knapweeds.

Russian olive was also identified as a problematic species. Rachel G., as noted, believes it was introduced by the Extension Service and has “grown to be a nuisance.” Lloyd D. notices the irony of species listing, “When I was a kid we planted Russian olives for windbreaks. We planted them by the mile. Now they’re paying people to tear them out. I don’t know why. I mean, they’re manageable. I guess they don’t like the burrs and stuff. When…my folks moved to this country they make a windbreak fast… there [were] no other trees around.” Russian olive is now on the Fremont County Weed and Pest noxious weed list but Lars B. explains, “It’s a tree that does have value for windbreaks, erosion and shade. I see it as an improvement on what was there in some cases, but the problem is, it doesn’t stay put. There’s a problem with cottonwood regeneration on the Big Horn [river] and we have to deal with that… you can kill it. That’s the easy part, but you can’t get rid of the dead tree. That’s the part that costs money.” Randy C. expresses the need for cooperative management with invasive plants, “If you’re on a section of a stream…and you try to deal with Russian olive on that section,
it’s probably not going to do you a lot of good if nobody upstream is working on it.”

Tamarisk or salt cedar is another plant recognized by agencies as a problem, though not often discussed by other interviewees. U.S. Fish and Game staff report that, “It’s all the way up though the Popo Agie [River] now. It’s been encroaching. For years they used to say ‘well, tamarisk won’t be an issue in this area because it’s too high elevation’. Whether it’s climate change or whether people were just wrong, it’s really expanding.” Pat H. now finds salt cedar at all the reservation reservoirs, including Bull Lake and Dinwoody, “You can just about go anywhere and find it to some degree. It’s not in the abundance that you find around Boysen but it’s probably just a matter of time.” Scott R. noticed that tamarisk was so prolific that “the seedlings of that stuff looked like grass” at the confluence of the Big and Little Wind River and Dave S. adds, “we just assume it’s moving up river.” Upstream, at Crowheart, Ralph U. does not recognize it as a problem. Conversely, he says, “There’s only one plant of salt cedar on any property we’ve ever owned. It just showed up. It was on a plain old bare hillside. When it blossomed, here’s a tree six or eight feet tall covered in pink blossoms and it was out on a bare hillside you can’t miss it.” Lars B. suspects salt cedar was introduced to the basin in the 1950s by the Bureau of Reclamation to remediate the erosion problem on Fivemile Creek. Pat H., when asked of the origin of salt cedar asks, “Well didn’t the Bureau of Reclamation plant tamarisk down there [Muddy Creek]?” Though neither individual knows for sure, Lars B. remembers a researcher noting that he found several plants growing in a row
equidistance apart and believed it had been planted. Lars B. describes Boysen Reservoir as “lined” with salt cedar and has encroached upstream, and into creeks, from there. He recognizes the upper end of Bull Lake as its westernmost extent where U.S. Fish and Wildlife staff believe it was introduced by boat.

**Perceptions of Weed Management:** Weeds are managed cooperatively in Fremont County, which includes reservation lands. Land owners, the tribes, and Fremont County Weed and Pest share weed control responsibilities.

Fremont County's Weed and Pest is the central hub, but Lars B. describes it as “a system of shared powers,” and not a hierarchy. It is a relationship between the federal government, the state, tribes and the county, “Integrated pest management is when you work together cooperatively to erase the boundary.” He describes Fremont County Weed and Pest as a special district, like a school district, which funds its programs through taxation. Tribal lands are slightly different. Both Don A. and Lars B. recognize that weed control is part of a treaty relationship between tribes and federal government. Don A. says, “It is a big trust responsibility on behalf of the Bureau of Indian Affairs and the EPA.” He explains that the EPA runs herbicide and pesticide programs for the tribes as well as the BIA “through its trust responsibility in taking care of the lands. We, in the Wind River environmental program, do not pursue getting a pesticide or herbicide program here because I think the BIA is responsible for that and…I don’t want to excuse them from their trust responsibility to the tribes.” Lars B. explains that
funds from oil and gas royalties “go into a pot in Cheyenne” which helps provide weed management on reservation lands.

When asked if the complicated land ownership mosaic causes problems with weed management, Lars B. responds that trust land is not a problem, but occasionally “fee land can get complicated with an absentee owner. I can spray all the weeds on a place in an hour. The paperwork takes longer than the treatment.” Ben W. notes that, “County Weed and Pest goes in on tribal ground and does have some hand spraying. They get it coordinated pretty good. The difference is I have to pay for my spray and they don’t.” Ralph U. says:

Some people take care of weeds and some people don’t. It don’t matter whether they’re Indian or not. It’s just people…We have a list of noxious weeds we’re supposed to be taking care of, which some of us don’t do a very good job of. The county tries to do a good job. They subsidize your spray material, like Roundup and stuff like that. They’ll cost share with you on all of that. And they'll even come in and spray for you but you have to pay 'em. [Otherwise] you do the work.

Ralph U. remembers when Weed and Pest aggressively began spraying leafy spurge:

With leafy spurge they would give you all the materials if you sprayed. It didn’t cost you anything if you would spray leafy spurge. It was so bad that they just handed out the Toradon or whatever. I had one little patch up here, oh, not much bigger than this table…so I keep telling Lars I thought he oughta give me at least five gallons of Toradon. He just laughed at me. ‘A little patch like that? You don’t get five gallons of Toradon!’ So I didn’t get away with that one either but I think I got it all killed.

The Weed and Pest program is responsible for certification of weed seed free hay. Lloyd D. explains:
Fremont County has a very good weed-pest program. They come and check my fields every year and in ten days of cutting he says ‘yes’ or ‘no’. I’ve been working with them long enough to know there’s no use to call them on some of the fields. I do something else with it. Usually I put a plow to it or we’ll spray it or something. But they come out and walk the field and say ‘no you can’t’ or ‘yes you can’. And we put [colored] twine on each bale that makes it certified. I do all the hauling and I sort them off. I’ve been in it long enough to know that I can pretty well pick a bale that I don’t like the looks of it… and we set them aside. I have four hundred and eighty bales out here that will not be cubed. They are not certifiable because of weeds or whatever. In my business I can’t be accused of sending that kind of junk anywhere.

Some weeds are handled through aggressive pesticide application and others evolve on their own. Ralph U. explains:

    We have patches up here of solid knapweed, [on] Indian land. Nobody’s sprayed it, nobody hadn’t done anything to it for years. And at one time it was just solid knapweed, and we was looking at it… and it was remarkable this year that there’s as much brome grass there as there is knapweed. The brome grass has moved into the knapweed… It has to be the cycle of things.

Ralph U. notes that, “My horses run up the draw here and ate the heads of every knapweed… Maybe that’s the reason the brome has a chance to come back, because they have pastured the knapweed down close enough so that when it come up in the spring why the brome grass has a chance to get started.” He explains weeds as “something to live with. We spray it,” but other weeds take care of themselves, “just like these horses going up the draw here and eating the tops on all the knapweed. It ain’t going to seed this year. It won’t have a chance, not with these saddle horses” and if a fire burns through the riverbottom, as it did several years ago, “it all comes back up solid Canada thistle. Those seeds are all
laying right there in the soil... but after a year or two why it all thins out. Livestock eats it. They’ll eat it all off.”

Lloyd D. explains weed management on his lands, “They’re somewhat of a problem, but it’s like anything else. You can manage it and you can farm it. There are three weeds that give me the most trouble: one of them’s knapweed, one of them’s whitetop and one of them’s Canadian thistle.” Weed management is not the same for every crop:

If I wanted to farm... in certain ways... they’re not a problem... If I put those crops into barley or something, then I can nail those crops with chemicals. But when you start messing with broadleaf herbicide, then they’re very selective... You can take Milestone, Milestone will nail Canadian thistle, but it kills everything else too. But it’s not like Toradon, it doesn’t kill the soil.

Lloyd D.’s best strategy for weed control is, “…to have a very good stand of alfalfa and make it so thick the weeds don’t want to compete.” Lloyd D. applies Roundup “a couple times when it’s out” but does not believe Roundup Ready alfalfa is the best variety to grow for his needs, “I have other varieties that are so much better.” If weed problems become extreme, Lloyd D. explains:

I till it. I just Roundup it and till it [and] there are chemicals you can spot spray and get those weeds. But it’s like anything else; if you let them go to seed, then they propagate and that’s the secret of weeds. The best way for me to control weeds is to harvest them. And the perennials, you got to use a herbicide on them: sunflowers and stuff like that, cockleburs, anything that’s an annual, kosha. Harvest it. Never let it go to seed. Harvest it.

While weed management is generally considered positive, some interviewees expressed concern over methods of weed control. Richard Baldes refuses to allow the county to spray the ditches on his land and Don A. worries
about the broad impacts of different sprays, as previously mentioned. He believes long term evaluations of environmental effects are necessary.

Lloyd D. expresses his concerns for conflicting practices of weed management:

A lot of our weed problems are on the surrounding land, on the range lands, on the river bottom. Down on the bottom of this valley there’s this crick, Fivemile. Game and Fish and the riparian people do not want anybody in there spraying anything because of the habitat, and it’s loaded with knapweed and Canadian thistle. So we kind of battle against each other… It’s kind of a give and take on that.

Part 2: Perceptions of Riparian Areas and a Century of Change in the Wind River Basin

Figure 3.6 The Wind River south of Riverton. The Wind River (right) is bordered by a gravel pit (left) near the cribs that used to hold railroad ties floated downriver from Dubois. Basin residents have mixed perception of changes over the last century.
Interviewees were asked to describe broader positive and negative changes affecting Wind River riparian areas over the past century (Figure 3.6). Their responses have been organized in common themes: climate, irrigation, wildlife regulations, groundwater, litigation, and land use change. Each category includes a variety of perspectives.

Climate

Figure 3.7 High flow, 2005. Spring runoff inundates island and pools above the Diversion Dam. Interviewees notice lower flows now than in the past.

Several interviewees recognize a shift toward a warmer, drier climate. Kathy Gervais notices, “The Big Wind—in the summer you could hear it roar. It doesn’t come at once like it used to.” John W. agrees:

In 1966 I remember hearing the river—water everywhere. It’s really changed. You hear the runoff but not like it used to be. It doesn’t flood the whole bottom like it used to. There are not as many wetlands, not as much precipitation. Meadow creek used
to flood. You don't see it like it used to be. Maybe our environment is changing... If you go fishing, the lakes aren't as full as they used to be. The water levels are down, even in the reservoirs that the cows used to drink.

John remembers, “The winter of 1949, it was cold. I mean it was cold. Cows were freezing standing up in the fields. You never hear of that now.” Kathy G. notes, “I remember as a kid that your nostrils got froze together when you went outside. That’s what’s changed.” John asks, “Is it because I’ve got better clothes?” and laughs, but no, “It was unbelievable in the winter time.”

Ralph U. remembers as a five year old, driving a Model T across the iced over Wind River in order to take a piano from Connell School to Burris School for the Christmas concert. The schools shared one piano between them. With respect to river ice, Ralph U. says, “We haven’t had that for 20 or 30 years. It always froze up solid. You could drive across it anyplace. Not anymore.”

Reba T. considers climate change the worst change in the past hundred years. Reba recalls, “I left home when I was 14. That was in ‘69. I actually started going to boarding school, Flandreau Indian School...I always came home for Sundance ceremony, all through my life until 2002, when I finally came home.” Reba remembers coming home in 1986 and noticing snowfields on the mountains melting for the first time “and they never melted before.” She describes:

They were always there. I noticed them shrinking a little then all of a sudden there they were gone. It was all grey. And today every summer they melt. They’ve never been established again. We had really bad drought at that time, about four years of really tough [weather], our warm valley was just brown and yellow. Everything was just dried out.
Rachel notices that when tribal members visit with one another, changing weather sometimes comes up in conversation:

You hear them say it never used to be warm in the winter. It used to be cold and stay cold. We used to have a lot of snow. That’s the type of stories you hear. They just notice that the river is really low, that the river used to flow and that’s where they used to get their water and now it’s all drained... They notice those things. They notice the ditches aren't as full. They see the changes. I’m not the only one that sees the changes. They talk about it as they visit.

Interviewees vary in their sense of how a changing climate will affect riparian areas and communities. Berthenia C. believes climate change will make the irrigation of some lands unviable. “The glaciers are disappearing. You know all that upper bench area in Crowheart is dependent on the Dinwoody Glacier for late season flows and they’re not gonna have that in 20 years, 15 years; it will disappear.” Dave S. believes glacial recession will affect the Crowheart area severely, “Late season flows in that area are gonna go ‘bye bye’. So that’s why you’re seeing a lot more pivots going in up there. Open ditches are going to be a thing of the past. Eventually water’s gonna get tight up there, and actually those are some of the better lands. They’re a heck of a lot better than what you see in the reclamation project.” Pat H. remembers discussing glacial melt with a rancher in the Crowheart area who said, “…my daughter doesn’t want the ranch because she’s thinking that the glaciers are gonna be gone and we’re not gonna be able to ranch here,” so Pat H. thinks some Crowheart residents are already planning for a different water future. Scott R. believes vegetation distributions may be
changing and hypothesizes that the rate of tamarisk spread may relate to climate change.

Ralph U. has a different opinion of climate change. “It’s just natural. We had an ice age 50 or 60 thousand years ago, and I’d say we’ll have it again.” Ralph compares it to the fluctuations in the river’s course and alterations in natural cycles. When asked if he is concerned for himself, Ralph U. says, “No, because we’re not gonna be alive then.” When asked about his kids he says, “They’ll be gone. We don’t live forever and neither do they.” He says, “No, [we] don’t worry about it. There will be water as long as we’re here,” but then he laughs and remembers having surgery at age seventy, when the doctor promised him another twenty--five years.

Jolene C. believes in more proactive management:

I’m hoping that the river will be better managed in the future. I’m hoping that we won’t see these terrible standing puddles of water over the summer [rather than flowing water]. I think what’s really going to force that is climate change. All of us are going to have to look at the management of the river. In times of shortages we really need to be sharing more than what we do. Our rivers are glacially fed and our glaciers are dying. It’s going to have a huge impact on the water levels in the river. It’s kind of like our economy. We lived on credit, and more credit and more credit, and now people are looking at their lives and ways of extravagance and saying that we can’t do that any more. We’re going to be facing severe water shortages in the future, and we’re going to have to be a lot more efficient with our water management. And hopefully we’ll have more strategically informed young people who are taking over management decisions and more willing to collaborate on projects together instead of litigate. That’s my wish.
While nearly all interviewees recognize irrigation as a central factor in riparian change over the past 100 years, not all basin residents have the same perspectives on that change (Figure 3.8).

When asked to name the three worst changes in the Wind River riparian area over the past century, Geoff O. responds, “You know you could almost tick off irrigation projects and just make them your top three.” He lists Diversion Dam, and withdrawals from Riverton Valley and LeClair as the main culprit. “Generally diversion projects are a problem because they have been so profligate in the way they pull water and throw it back in for a crop.” Dave S. of U.S. Fish and Wildlife expresses a similar point of view, listing Diversion Dam as the worst river impact in the past century, “Well [the worst change] would certainly be in the thirties with Diversion Dam. That altered the entire system. Bull Lake and Diversion Dam
altered the entire system.” Jolene C. says, “The irrigation systems have opened up the area to flood irrigation and have had huge impacts on the water levels in the rivers.” Richard B. believes, “Well, certainly the irrigation has a tremendous impact for a number of reasons.” He laments the dewatering effects of Diversion Dam and its impact on invertebrates and fish. John W. similarly expresses, “The Wyoming Canal has had a lot of impact. There are more changes downstream than upstream. The Diversion Dam has had a tremendous impact.” John W. remembers friends fishing near Johnstown, downstream of Diversion Dam, “If you can catch a fish there now you’re the luckiest fisherman around.” Berthenia C., Reba T., Iva R., Sherry B., and Rachel G. list excessive irrigation withdrawals as the worst changes in Wind River riparian areas over the past 100 years. Berthenia C. believes return flows are an additional concern, “I think the dewatering is the biggest issue, and that’s Diversion Dam…both the taking of the water out of the river and the return flows with the junk in it.” Randy Croft of the Nature Conservancy says of Bull Lake Creek, the conduit between Bull Lake Reservoir and the Wind River, “If we maintain 50 cfs in the river at key times of the year we’re doing pretty good because the irrigation district wants to hold that water back.”

Conversely, irrigation is seen as one of the most positive changes in the century by three interviewees. Similarly to Geoff O., when asked to name the three most positive changes in the Wind River area over the past century, Ralph U. will only list one, “Cultivation. None of this was farmed in 1940. Nothing was
farmed in 1940. It was all just sheep range. That’s it, cultivation.” Lloyd D., of the Riverton Irrigation project emphasizes:

> Well, this project has been more than a success… we don’t make as much per acre gross as other people do, but we do it more consistently. We don’t do it on such a big magnitude as they do, and it’s a good lifestyle. And what are you going to do with this ground if you don’t do that, see? We’re not that big. We’re little fish in a big pond, so to speak, but everybody’s little fish somewhere…we raise excellent crops.

In addition to supporting agriculture, Lars B. lists the most positive change of the century as “flood irrigation” and believes it has improved riparian areas overall. He explains that when Raynolds and his expedition (1859-1860) arrived at the Big and Little Wind Rivers, “He rode 18 miles for horse feed and wood for the campfires. In the great days of the Rendezvous, the site didn’t look like that at all. Not a tree in sight. The spring water caused a deep channel and the water table was too deep. In dry years, there was no grass.”

While attitudes toward Diversion Dam and dewatering may appear to split largely on agricultural, conservation, and cultural lines, these divisions simplify perspectives. Many tribal members do not oppose irrigation, and Geoff O. emphasizes, “I don’t mind dams, I really don’t. … That’s just not a good place for a dam and I can’t think that what’s done with the water really contributes that much to the economy.”

Rachel G. and Sherry B. believe a better tribal irrigation infrastructure could contribute to the tribal economy. Rachel G. hopes:

> …that we start building up our own resources to increase…our water infrastructure, building a good water system for our people…. Maybe in the future we’ll build a dam up there that’s
just for the use of the people here in these communities instead of for the use of it down in Boysen, and that we can create more farming for our tribe... we can do more sugar beets, we can do more hay, alfalfa, we can do beans, we can... use more water and create more jobs for the economic growth of the tribe... That's my vision for the water use in the next 50 years and that's why I'm working on projects to hopefully influence younger people to look at why we need to use the water, save it, and why it's so sacred to us at the same time: value its use and make sure that they understand that it's very sacred to us in our culture. So we want to use it in both ways, to provide us spiritually with life, and... to use on our land, to grow crops even.

Sherry B. also believes in irrigation development:

A lot of tribal land, especially in remote areas is just totally undeveloped, just sagebrush covered and just in a natural state and... I think if we could get some of those acreages irrigated and have some type of industry for the tribes, grow wheat, grow oats, grow something, why couldn't we do that? Especially because a lot of people here don't work. Irrigation wouldn't be an answer to all of our economic problems, but it would help stimulate a certain part of the economy here... I think they need to make a little bit more use of the land that we have. It just sits there, darnit, year after year and if there's something that they can be doing with it, they should try to develop it.

Reba T. suggests, “Antelope Flats, where we have our Sundance, that is very flat land” and irrigation could be developed there.

**Tribal Game Code**

Interviewees were asked to describe the three most significant changes in Wind River riparian areas over the past century. All Crowheart residents described the positive increase in large game as a result of the Tribal Game Code (Figure 3.9). The Game Code was established in 1984 by the tribes in response to declining game populations on reservation lands. It required hunting regulations and monitored game species in order to bolster species of concern.
Kathy G. reflects, “I think we do have more big game than we used to, since game codes.” John W. inserts, “I almost ran over a bear last fall.” He adds:

There’s a lot more wildlife now: wolves, coyotes, mountain lions. That’s because of the game codes. Prior to the game code, you could still hunt and get game, but you’d have to do a lot of hunting [to harvest an animal] and now you could just go shoot a deer if you want to and if it’s in season. The only thing I’d say didn’t come back is moose. It didn’t come back in the same numbers.

Ben W. notes that he shot a mountain lion the day before our interview and says:

I think that there’s more wildlife on the river today—I know there is—than there was twenty years ago. There’s more deer. Of course, the whitetails have moved in, in the past twenty years; it used to be all mule deer. And there’s a few elk now, cruise up and down the river. It’s gotten better, a lot better. It’s been in the last twenty years that they’ve [the tribes] really started managing their wildlife.

Dave S. explains that the game code was controversial and after several years, finally went into effect in 1984. By 1986 the agency saw results.” Pat H. cites statistical changes:
You compare the numbers of elk, deer, antelope then versus now, sheep, moose, we’re probably at least five to six times more big game post-game code than pre-game code. So the game code has had an unbelievably positive effect for most species and of course, a lot of those critters are down along the Wind River corridor.

U.S. Fish and Game staff explain their role as an agency:

We just provide management for wildlife, the biology side, we have nothing to do with enforcement…We collect the data, we make the recommendations on seasons and bag limits for both fish and wildlife codes as well as provide a lot of environmental comment on oil and gas, timber, water, you name it…Any resource decisions that we make go to the tribal councils…

The tribes enforce the game code.

Figure 3.10 Bucks graze in a hayfield. Game is managed by the tribes on 2.2 million acres of reservation lands.

Richard B. says, “Most people, if you ask them, say that’s the best thing that ever happened. There’s more wildlife than they’ve ever seen.” He explains that tribal hunting values differ from the state and region, “The philosophy of managing wildlife on the Wind River Reservation is not the same philosophy that the states or federal government or anybody else uses. The tribes and the Fish and Wildlife Service base it on the needs of the people, but more importantly, the
populations of wildlife in certain areas." Richard B. explains that restrictions originally encouraged increase in populations, “but we have very few restrictions now except for bighorn sheep and moose because those populations will probably always be somewhat low, but everything else, other than maybe sage grouse, have just blossomed.” Richard B. sees the game code as enormously beneficial for tribal members, “You know, we can always have good fishing on the reservation because it’s controlled by the tribes. And we can limit the number of people. And the same with hunting. It’s the best hunting in the world because only about 1000 tribal members hunt (Figure 3.10).”

Groundwater Contamination

Figure 3.11 The Chem Trade Sulfuric Acid Plant, previously the Susquehanna Uranium Mill Processing Plant. Photo by Jolene Catron, 2009.

Most tribal members listed the Susquehanna Uranium Mill tailings as one of the top three worst changes in Wind River riparian areas over the past 100 years (Figure 3.11). The area is commonly referred to as “the Susquehanna" or
“the mill tailings cite” and is located south of Riverton just upstream from the confluence of the Wind River and the Little Wind River.

Sherry B. and her family have lived their lives between the mill tailings site and the Little Wind River just above the confluence:

We would spend all summer at the river. Everyday. I mean I used to swim every single day. During that time, I never realized that that Susquehanna mill was gonna have an impact on the water. It never even occurred to me. My earliest memories of my family, my parents, my uncles and my aunts and my grandma, everybody would go down to the river and there was a lot of currants and a lot of bullberries and stuff down there and so we were always picking berries all the time and take them home to my grandma. And she’d always cook us frybread and gravy. And then there were even times when my grandma and my aunts, they’d go to the river with my grandma and they’d all wash clothes down there. They had one of those old washboards. They would all sit there and they’d put towels on their head because it would be so hot, they would all sit there right by the river and wash their clothes. And I guess I didn’t know we were poor then because it was normal. During the winter times we’d go down there on the river and skate on the ice, much to my parents chagrin. They hated that. It was lots of fun. But I can remember swimming all the summers down there when I was a kid. It was a lot of fun growing up by the river.

Then as I got older I began to realize that we have these uranium mill tailings there and I began to wonder what kind of impact it was having on people who resided within a real close vicinity to that mill. It was kind of scary because it seemed like a lot of people started getting cancer and my mother passed away from Lou Gehrig’s disease and that’s real uncommon in Native Americans. So I always wondered if part of her illness could have been attributed to any kind of toxicity of any of those chemicals that came out of that place.

Sherry B. is also concerned about the area since it developed into a sulfuric acid plant:

I remember when we were kids, we’d go stand there down at the turnoff and we’d watch these big tanker trucks, they looked like milk trucks, big silver tanks…They’d have a big hole up on
top at the end of each of those tanks and I guess that’s where they’d put the cake in, the yellow cake. And it would flow out, it would just flow down the back of that truck and it would leave a big long trail all the way from that mill down to where they were hauling it. It used to really make me curious because when you’re a kid you see a bright color like that and you want to go over and touch it and see what it is, but for some reason we didn’t do that. We’d see it, because we’d have to stand right there to wait for our school busses—I had a ton of cousins and myself and my siblings that would stand down there, boy there was a whole bunch of us—but we never really did bother that stuff. I’m so glad now.

Jolene C. currently leads an Environmental Protection Agency CARE grant (Community Action for a Renewed Environment) designed to promote community action toward the reduction of local toxic pollution. Her work focuses on the Arapahoe and St. Stephens communities. Her largest concern for riparian areas is “the uranium mill tailings site from the 50s and 60s [and its] radioactive legacy of waste in the shallow aquifers.” She explains that the Department of Energy was negligent in their response:

The Department of Energy came in and cleaned up the tailings that were piled around and took them back out to the gas hills. They were piled on the ground without a liner, so the radioactive stuff leached into the ground and into the ground water. There’s now a public water line, but these pipes go through the shallow aquifer where the plume is. Instead of building around the groundwater plume, they put the line right through the middle of it.

Jolene C. laments, “They’re finding higher levels of radionuclides on the ends. Whether that’s naturally occurring or whether it’s from the tailings, we’re not sure. But people in St. Stevens are dying of cancers and a lot of people are scared about it. There’s been so much cancer in those communities.” Jolene C. is working to promote awareness in areas that are unmarked, particularly in areas
accessible to the public, “Kids swim in that water. It’s polluting a lake that’s very accessible and it’s in an area where people sustain themselves in a cultural way” (collecting berries, for example). Jolene C. complains:

DOE comes in and they have their requirements to do public meetings, quarterly, and they do these powerpoints with an engineer up front who talks a whole different language, and they pack up and leave without having offered any information useful to the community. They just check their box that they did a community meeting. We need to hold DOE’s feet to the fire. It’s an environmental justice issue.

Berthenia C. explains that a model was constructed to predict the flow of the contaminants:

But they didn’t take into account the paleochannels and a lot of other things. So there’s been a long running relationship with DOE to get them to do the right thing. Their cleanup strategy is natural attenuation so they have to be able to say how long it’s going to take and where it goes. And they know it’s hit the Little Wind now...people aren’t supposed to be using groundwater in that area and there have been a number of places where it’s been daylighted with gravel operations or with flood events. There’s an oxbow lake now that’s really hot that they didn’t anticipate. So now the surface water is contaminated.

Rachel G. refers to Susquehanna as “a hazardous, poisonous site” and “a lot of people live in that community down there.” She finds the fragmentary jurisdictions frustrating, “the federal government, EPA, DOE, it’s hard to get their attention. And it’s hard for them to get over here and change their mind about things.” She’s emphatic that “the clean up has to take place down there. Maybe it’ll never happen, but it’s going to affect those people downstream drinking that water and using that water.” Rachel G. broadens her concerns to toxicity in drinking water supplies in other areas. The Ethete community is often on boil
orders, and the tap water source is not always secure. She emphasizes that “there’s some big concerns and we’re trying to work on those issues.”

In addition to uranium contamination Geoff O. references fracking, the process of injecting fluids to extract oil or gas as “a whole new issue developing up in the Pavillion area…They’re finding pollutants in the ground water, in well water. He believes this contamination will eventually find itself in the river systems and regrets that “the state isn’t interested in regulating oil and gas and the liquids they’re putting into the ground.” Geoff O. believes that groundwater contamination is often overlooked, “I think it’s bigger than people realize and it affects all the water flows around here.”

Litigation

Many interviewees discuss litigation as an ongoing and volatile force in riparian change. When asked if the court cases are over, Berthenia C., lawyer for the Arapaho Tribe says, “Oh, I’m not a fortune teller, but I do think that nobody’s going anywhere…I’ve been working in this community for thirty years, and I’ve been working on Indian and tribal issues for twenty-five years…It’s one resource battle after another from the very beginning. And I don’t see that ending.” Dave S. expresses a similar opinion, “No, I can assure you it’s not over. It’s still on the hot plate as far as water. As years go on that water will only become more valuable” and Richard B. says, “No that story isn’t done. That battle is still going on. I don’t know whether there’s a chance that they [the tribes] would ever have the control, but I think people are starting to realize that the philosophy the tribes
have of water, and using water, and the importance of water to all life is a much better viewpoint than looking at it from one or two agricultural uses.”

Lloyd D. expresses a very different opinion, “I’m sure you’ve heard it,” he comments:

This part [the Riverton Project] is part of a withdrawn area from the reservation and there are some hard feelings between here and there. The government paid for it and now the price is worth so much, they want more money. That’s number one. Number two is we’re fighting over the water in the river, because there’s never enough.

Berthenia C. notes that one can certainly read Wind River litigations as “the history of non-Indians trying to take what belongs to the tribes away from them. Certainly. Yes,” but adds, “Of course, that’s what I do. I try to prevent further losses and we try to regain some ground.” Tribal members and conservationists see past litigations as both success and failures. While the Federal Supreme Court case is seen as a victory, the overall result leaves tribal members feeling that particularly the state courts continue to fail them. Berthenia C. explains, “I think in the world of Indian reserved rights, Wind River is seen as a pyrrhic victory that the tribes won, but in the end they haven’t been able to do anything with the water because there was so much bitterness and so much resistance continued after that.”

Reba T. expresses dismay at the history of government relationships with the tribes, “They made us abide by the treaty, but they didn’t have to.” She believes this ethic and its continuous history prevent tribes from exercising their rights:
We have to use our water for agriculture and nothing else. We could have an electrical plant, a water plant, even a recreation area, like a reservoir… We could have all that, because we’re first water users, but we’re not allowed to. So that’s a really bad thing. It’s not fair. You know, we have that right: the Bighorn decree. We have the rights but we’re not allowed to do anything.

Geoff O. believes the tribes’ assertion of their water rights was one of the most positive events affecting riparian areas over the past century, despite their lack of success in overall water management in the basin, “Most of what they’ve tried to do is with a better idea of what beneficial use is than the state has. It includes instream flows and, again, they’re not succeeding at it, but it’s had an effect. It made the state look at it and at least try, gently nudge, toward some instream flow protection.” Richard B. similarly says, “The battle that the tribes fought for water, control of the water and keeping water in the rivers, that’s a landmark and everybody—the tribes and the people involved with that—should be proud of that.” Like many tribal members, Richard B. laments that tribes, in the end, did not maintain control of water in the basin. He believes if they had:

Everybody would have won… They’d be doing a much better job than the state of Wyoming is doing. And the farmers would still get the water that they’re entitled to and that they need…. that would be better for all people whether they’re living on the reservation and are Indians or not. It doesn’t make any difference.

Berthenia C. emphasizes that one of the problems with Indian law is that it can be “just as much politics as it is law. When you’re getting close to what you think is a solution in law there’s a political side of it that you always have to put into the mix. You can’t ever get a resolution on the law side.” Dave S. believes politics overpowers law. Irrigation water withdrawals exceed legal entitlement and
the current legal limits are not enforced, according to Dave S. He describes the instream flows of 1989, when the tribes decided to maintain a minimum of 250 cfs in the river following the Bighorn decree and preceding the state Supreme Court ruling. Dave S. explains that the tribes asked the U.S. Fish and Wildlife Service to assist with reestablishing a trout fishery on the Wind River. “So, in 1990 they [the tribes ] dedicated 250 cfs,” he explains. “The state couldn’t challenge them that first year. It took them completely off guard. They didn’t know what they were gonna do.” Tribes were stocking fish amidst an outcry from the agriculturalists. The political backlash banned all fish stocking by the U.S. Fish and Wildlife Service, until the National Wildlife Federation brought in CBS and NBC, “and put it in the eye of the nation.“ Dave S. continues:

That was a 70 percent-of-snowpack year and at the end of that year the Riverton paper [reported that it] was a bumper year, record year production for all commodities. At that time they were producing not only beets in the lower system but also barley for Coors and Budweiser, and alfalfa. All those cash crops, including corn, were bumper crops.

Dave S. remembers asking the State Engineer, “How can this happen when we had a 70 percent of average [water] year?” According to Dave S. the State Engineer responded, “We made them regulate the water. We regulated the water and they used it more efficiently. I said, ‘Why don’t you do that every year?’ ‘Because we never had to.’ That’s how he said it, ‘We never had to.’” Dave explains, “In many cases they’re taking up to eight to ten times their legal water entitlement, but nobody’s regulating…Double is the norm…” Dave S. continues, “It’s not that uncommon to see them at the point of Diversion Dam taking six to
ten times the legal entitlement for that landscape. So if everyone just took their legal entitlement, we wouldn’t have a problem with it.”

Many conservationists and tribal members do not believe litigation is the best way of managing conflict along the river. Berthenia C. says:

Actually I think we have a system that rewards people for continuing to fight and I don’t think that that’s the right way to do it, but I’m not sure how to bring people to the table. I’ve come to learn that there are a lot of irrational factors. When you’re in law school they teach you [that] people do the economically rational thing… that’s what the legal system tends to deal with, they deal with money and how much is this worth, how much is that worth. People aren’t like that. Things drive them that have nothing to do with common sense or economic rationality. If you think about all the money that was thrown away in the water adjudication alone, 30 or 40 million dollars, if that had been invested in water development projects that would help everybody, think where we’d be today. I mean, riparian restoration among other things.

Dave S. expresses a similar opinion:

I don’t know if litigation is gonna resolve it. One of these days, and I don’t know if I’ll live long enough to see it, but the state of Wyoming better get to the negotiation tables. That would be the best thing that they could do right now, while they have the money, is to start working with the tribes, because if they don’t it will cost them painfully. They know there’s enough water in this system to make everyone happy as well as other uses as well. It’s just a matter of regulation…why are we spending tens of millions of dollars putting pivots in and gated pipe and all this stuff throughout the landscape of the Wind River drainage and not seeing any water conservation at all?

Referring to Department of Agriculture costshares on water conservation materials, Skates says, “The taxpayers are getting ripped off in my opinion.”
Berthenia C. believes other tribes have learned from the Wind River example, “It turns out that that’s not the right way to do it. A negotiated agreement is better.” She describes an example:

Crow came down a couple years ago, the Crow vice chairman, and told us they had negotiated a compact with Montana, and they said they learned a lot from the Wind River experience: what not to do. They decided it would be better to reach a settlement agreement and, if it’s ever ratified by Congress (the bill is in front of the Senate Indian affairs committee now) they got the water and they also got the money to implement their water rights. Wind River didn’t get any money, they just got the water, so they [Wind River tribes] didn’t have the means to implement the rights that they got.

Reflecting on the difference between the tribes’ strategies, Berthenia C. says, “I think it’s an accident of history.” She adds, “The Crow Tribe will get something like $300 million dollars over a period of years to do various things, to develop certain things. You really need that kind of investment to make something of your paper right.”

Despite her preference for negotiation over litigation, Berthenia C. believes the recent Hubenka case was a victory for the tribes, in which John Hubenka was convicted for diverting the river. “That to me is another sign of a change… That kind of cavalier cowboy alteration of the river will not be tolerated the way it used to be…the U.S. Attorney’s office finally did something” with the help of EPA, “The EPA was the one that said you can’t be doing that anymore.” She laments that the river has not been restored, “He hasn’t fixed it. It hasn’t been fixed. But…he is a convicted felon.”
Don A. also considers litigation as a means of reestablishing tribal sovereignty over their resources:

Here on the Wind River we’re in the process of pursuing what they call Treatment in the same manner as a State, abbreviated TAS. TAS is where if they acknowledge that a tribe is as capable as a state to run programs then EPA will give you primacy over those programs. That includes safe drinking water, the Clean Air Act, water quality standards… anybody violating these tribal standards is in a sense in violation of the Clean Water Act or Clean Air Act…they can wind up in federal court…if you violate federal law you go to the federal courts.

Aragon believes TAS will spur litigation. His concern is that “when we take these type of cases into federal court, if we blow it, we set a very bad precedent for other tribes as well as ourselves… so we got to be on guard about this stuff. And so there has to be a lot of thought in taking over these programs. Do we or do we not feel that we can run them?” Don believes TAS status could significantly impact riparian areas through the establishment and enforcements of water quality standards.

Land Use Change

Land ownership on fee lands and non-reservation lands north of the river is changing, and several interviewees believe this will have an impact on the river.

In Crowheart, several interviewees note increases in property values, more conservation buyers, non-resident land owners, and a change in the community overall. When asked why people are moving in, Ralph U. responds:

When you have buku millions you don’t have to have reasons. We have more millionaires here than any other place in the
United States. I don’t know whether they call them second homes or what. Most of them don’t live here. One or two or three of them do, but most of them don’t. They just come. A lot of them stay in the summertime.

Ralph says ownership can have an impact on ecological change, “If they have a good manager, they take care of the weeds, if they don’t they just let them go.” Ralph U. says the new owners have a different idea of how land should be used, “Oh, absolutely,” Ralph U. describes one owner from the West coast:

He’s got a place down here just the other side of Crowheart store about five or six miles. It’s a wildlife refuge. He owns three miles of Wind River, plus three hundred acres of alfalfa hay, plus he owns one of our old places along the river. He says ‘I don’t even want this pastured anymore.’ So they were cutting hay but they weren’t pasturing.

Ralph U.’s son Rusty works for a conservation buyer, Ralph explains:

And Rusty has a reputation of being probably one of the best trappers in Fremont County, hunter and guide and whatnot, so they were teasing [him] said ‘what did you do, hire the fox to take care of the chickens?’ But he has built a couple of ponds for wildlife, for ducks and stuff, with islands in it. Oh you don’t hunt there. Down along the river, it was all greasewood…and he cleaned it up and leveled it off and slowly getting something to grow and he had a wheat crop about yay big, and he was trying to disk it under for mulch…but he don’t want pasture. No livestock. Period. Just game.

When asked how he feels about the change, Ralph U. responds, “Fine. Yeah, he’s got the finance so there’s no problem at all.” Ralph U. describes other owners, someone from “New Jersey or someplace.” He explains:

The family on our original home site come here from California. Her family owned a ranch along the Pacific shore. Said when she was a little girl they punched cows up and down the beach. She isn’t hurting for money. And fine people. Just excellent people. You wouldn’t know that they were probably way up in the millionaires. You just don’t pay any attention to that. They’re
just nice people. They had a little place over here on the hill and they kind of liked it there. They was gonna build a house up there where the wind blows the hardest, and Rusty—how he got to know them I have no idea—[asked them] why build a house up here…?

They moved down to the riverbottom. “Here they’ve got deer, moose, riverbottom, everything where up on the hill they’d have nothing but wind and they are just absolutely elated. But they put up their hay and pasture cows, but they still have all kind of wildlife and just great. Just great. And they got their million dollar home, no problem (Figure 3.12).”

On the other side of the river and surrounded by tribal land, Lee Wilkes says, “Nothing’s changed here since we’ve been here as far as more neighbors or anything like that. Which is good.” Kathy W. notices, “Up by Dubois there’s lots and lots of houses just jammed in there fairly close together around the river and stuff, so they’re just subdividing. Most of them are like summer homes, or a lot of them are” but this development isn’t affecting the north side of the river, “Not so much I don’t think.”

Figure 3.12 Relatively new house is perched on the northern bank of the highly mobile Wind River. Interviewees note that newcomers build large houses, and are sometimes surprised by the environmental conditions of the Basin.
John W. no longer lives in Crowheart, but still owns land, “There are a lot of families that used to not be up there. People you don’t know.” He illustrates this with an encounter with a stranger he had on his land, “On the way in to my land one time this guy said, ‘What are you doing out here? You’re sitting on my land!’ and I had to say, ‘What are YOU doing up here? This is MY land you’re on.’” Describing fee lands on Willow Creek (a tributary to the Wind River) John W. says, “You have to have money to live there. I can remember a time when we were all about the same financially and struggling.” John remembers figuring out that if he and a friend sat underneath their horses at the Crowheart store, tourists would give them money to take their pictures, enough to buy a soda and a candy bar, “Probably, fifteen cents but a lot to broke ass kids that only went to town twice a year.” Ralph U. expresses a similar sentiment:

Oh, back then everybody was working so hard just making a living, now those people don’t have to work hard for a living. And they hire help… I can remember in the depression days when they bought your cows and sheep and took them out and shot them just to get rid of them. The government did. They took them out there north of Crowheart Butte and you could bring your livestock and they’d shoot them and pay you for them. It’s a little different period then what we have now. Yeah it’s different.

John W. notes that he does not see the subdivision of land in Crowheart that he sees upstream near Dubois and downstream near Riverton, “They’re not subdividing at Crowheart. Lands still seem to be intact. Most people are still haying. The older people seem to have the same operations.”
The Wilkes and the Urbigkeits mention the history of the Wyoming Land and Cattle Company land, which is treated as a local saga. Ralph U. explains that it's changed hands several times, until recently:

Somebody back East, a rich guy, took it over and it went at auction to the people who have it now. They're from California. They didn't know a thing about what they were getting in to, it's not like California. They didn't even know they had to feed their cattle in winter. Before it turned over [the last time] the plan was to subdivide it and build million dollar homes – mind boggling – elegant homes, a swimming pool, tennis courts, a movie theater. They had parties from Jackson. They were that type, and when the tile in the pool didn’t match the tile on the sides, they pulled it all up and redid it.

Ralph describes, “They never sold the lots and it all blew up. They weren’t honest about it. They assumed they could hunt and fish, but they’re surrounded by reservation land and were cited for poaching by the tribal wardens and then they killed a bear and tried to take it out of state.” Certainly most of the newcomers are not as problematic, but the history of the current Wyoming Land and Cattle Company land illustrates an extreme lack of understanding of local land regulation and ethic (Figure 3.13).

Figure 3.13 Wyoming Land and Cattle Company pond next to the Wind River. Locals use this land saga as an example of changing land ethic in the Basin.
Newcomers, as a result of their management strategies, do have environmental fingerprints. The Nature Conservancy, for example, now owns the Winchester Ranch (former reservation land on the south side of the river near Crowheart) and manages the land with strict conservation objectives. Randy Croft emphasizes that, as an organization, they value native vegetation most, and “whatever has historically been there prior to European settlement….that’s going to be the starting point of what we want to conserve” In cases this is not possible, as Randy C. expresses. “We may not be able to ideally go back to what was there 200 years ago… but I’d say in general that’s what we’re shooting for.” While the Conservancy maintains ranching practices, and believes grazing can take place in riparian areas if it’s done carefully, it also diverges from traditional uses. For example, the Conservancy enhanced wetlands on the Winchester property by backing up water from the Winchester irrigation ditch that flows through the property. They have installed structures that prevent fish from entering irrigation canals from Bull Lake Creek and utilized reclaimed water from a nearby rest area for their wetland project. Randy C. talks about the pros and cons of conservation buying:

If you get some of those outside absentee landowners in, what they’re probably going to do is buy a big chunk of land and there will be some development. You’ll see a pretty good-sized house go in, probably some barns and that sort of thing. Sometimes the locals are challenged a little bit…if they knew the old ranch owners and they were people who had been in the community for decades---a lot of times they got to go out there and hunt, and had a good relationship with them. Well, sometimes the new folks who come in don’t necessarily feel quite that way about it and really restrict access to those lands. On the flipside,
you’ve got folks who don’t have the economic incentive to go ahead and chop that land up and sell it parcel by parcel.

This kind of subdivision is a concern downstream.

Downstream, land use change takes a different form. Lloyd D. describes:

A big thing now is this development. Where they’re coming in here and making these subdivisions, see. And the county has been very reluctant to do anything about that, but the last two or three years they’ve had to say ‘no more’…if you’re going to divide land…you have to follow their rules.” Subdivision causes problems on the irrigation project:

You drive around and you look, it used to be all agricultural, and if you look at our assessment roll today, you’re gonna find out most of our land is forty acres or less. People are moving out of town, coming from back East, out West, and they’re moving in here, buying chunks off of these farms. It’s a way of life. Everybody wants five acres and a horse.

Lloyd D. explains the difficulty in managing small acreages on an irrigation project. Midvale was forced to establish a first acre charge in which “if you draw one drop of water from Midvale irrigation district, you’re gonna pay $350 bucks every year. And that gives you up to five acres.” Lloyd D. explains this change:

We have more conflict in right of ways! A guy will cut off a corner of his farm and sell it to somebody else, 20 acres, but the headgate is way over here. How do you get the water over there? You can’t get over there because you don’t have an easement. What do they do? They come to our front door. And it creates a lot of problems.

In addition, subdivision causes headaches for the ditch riders. “We have a crew, we have nine of them in pickups and you put your ticket in and they turn the water in at these headgates every day. That’s their job. They do that. So here we
Lloyd says the ditch riders are “out there hassling around trying to settle disputes between land owners. It’s a problem, but it’s progress, and they’re slowly putting us out of business. We still get our money, but the big landowners in numbers are a lot less.”

Property values near Riverton rose dramatically in the first few years of the present century, and dropped with the economic downturn of 2008. Lloyd believes it’s cyclical, “Land at one time was over 2000 an acre, 2200, 24, and now it’s down to about 1500, 1400 with this economy the way it is…a real estate guy in Texas had some money, and bought a place over here and he’s taken a wash. He thought he could grow cattle, they wanted to have a guy up here,” and he thought he could sell for a profit, “and it didn’t happen. Now that land’s for sale, see, and he doesn’t want to take a loss, but he’s taking a loss.” Lloyd believes it was a gamble on the market but also a misunderstanding of the country by newcomers:

In this country especially if you want land to look good you farm it. You don’t graze it. If you want to produce, you till it, control the weeds, fertilize it, you irrigate it, you harvest it. Too many people come in here [the Riverton Irrigation Project] and think it’s cow country, and what they do is put a bunch of cows on irrigated ground. They got a wreck. You can’t produce anything. We got the kind of soil that packs good, we got shallow soil. It’s a combination of things. If you want to go broke, just pasture irrigated ground and try to make a living on it.

Berthenia C. believes this influx of amenity buyers may influence regional ethics:
I think that there is a mix of people who live in this basin who really like the values attached to a nice river system. That the idea that a nice river system is in and of itself not valuable just the way it is, I think that’s changed. And I think it has to do with the kinds of people who have moved here in the last generation. A lot of the people that didn’t have those values have moved on, either they’ve passed on or moved away and so I think there is a different sense… it used to be that the idea that leaving the water in the river was a waste… that is not universally true anymore. I mean, there are some people that still think that, but I think the majority of the people want to see running water. I think they prefer that. And I can see that particularly in the attitude of people around Riverton. As the development of the city has gone toward the river, south toward the river, and there are all these high end homes and golf courses and so forth, you know they want to have a nice stroll in the evening along the river and they don’t like to see it dried up and icky. They would prefer it to look like the Snake.

Geoff O’Gara expresses a slightly different perspective:

In Riverton, people who live by the river actually do care…I’ve heard some expressions of concern down there about all the practices of draining the river and bringing it back up and the lack of fish habitat and all that, in Riverton, primarily by people who live down off Riverview and are along the river there…there is a little higher consciousness of quality of life issues around the river.

Yet he is not optimistic about the impact of this new perspective on significant change:

It’s not very great, it’s just that it’s better than it used to be. You know the public consciousness idea that the river is just a tool for irrigating primarily, or industry… as opposed to part of an ecosystem that we need to just keep hands off or protected… that probably has accelerated in the past twenty or thirty years.

Geoff O. thinks part of what prevents conservation collaboration is, “people are so scared of the reservation, they don’t know how to assert [their beliefs].”
Scott R. of the U.S. Fish and Wildlife Service is not optimistic about the impact of newcomers on riparian change:

You know what I’ve noticed in the years that I’ve been here, I’ve seen these conservation buyers, if that’s what you call them, they come in buy their second home, ranch little thingy and then they hire a cowboy of some kind to come run it and they always continue to run cows and I’m sure take a tax write off from it. But it never fails, some good things get done because often they have the bucks to do it, they’ll fix a diversion, they’ll do this and that, but they’re still running cows on it; they can’t get away from being a cowboy. A ranch in Wyoming, by golly… They are putting some money into conservation practices and things but I’m sorry, just going to center pivot irrigation isn’t the answer to all of the problems. As a matter of fact, what I perceive is that there’s irrigation center pivots going in places they never should be.

Richard B. has served on several regional conservation boards, and offers a regional perspective to change. He believes that regional concerns for subdivision and ranch land fragmentation are not as relevant in the Wind River Basin (Figure 3.14):

It isn’t as big an issue here because most of the land on the reservation is owned by the Shoshone and Arapaho tribes. Some of it is owned by individual Indians, that’s called allotted land, and there’s also deeded lands, which can be owned by anybody. But that portion of land is only, maybe 20 percent or something like that. One of the reasons that we live out here is because of that very thing. I don’t see in our lifetime and maybe in our kids’ lifetime, and maybe ever, that this will look like Bozeman, where you’re worried about a gazillion homesites or two and a half acre plots or twenty acre land owners because most of the land is owned by the tribes and unless the tribes—jointly—say ‘this is what’s gonna happen to that,’ it’s not gonna happen to that.
Richard B. adds, “I’ve got some friends who really want to buy land here for that very reason; they know it will never be like the rest of the Greater Yellowstone Ecosystem and these little ranchettes, torn up. It’s not gonna happen here.” Richard B. predicts that growth “will happen near Fort Washakie, near Riverton, near Ethete, near Arapaho to some degree” but the best thing about tribal land is “it can be controlled” locally.

Part 3: Perception and Environmental Change in the Wind River Basin

It is dangerous to extrapolate broad conclusions from a handful of interviews. Rather, my intent in this discussion is to investigate the rich variety of human-environmental relationships in 24 perspectives of place. I suggest that the complex invisible landscapes depicted, as well as their tensions and collaborations, contribute to the ways place transforms. I draw five main conclusions from these interviews: 1) perceptions differ culturally, geographically,
and within different scales, 2) perceptions represent moral geographies that relate to environmental management conflicts, 3) mobile forms of nature provide particular challenges to shared landscapes and differing perceptions, but non-mobile nature presents challenges too, 4) perceptions exist among complex power dynamics and finally, 5) ecological and cultural resilience may relate to more democratic interactions between cultural groups.

Perception and Culture, Geography, and Scale

Different cultural groups recognize different aspects of landscape change. For example, only tribal members report significant decreases in berry bushes (buffalo berry, chokecherry, currant), certain medicinal and edible plants (yellow root, wild onion and carrot), and specifically plains cottonwoods. Only resource managers identify the extensive spread of tamarisk. Only agriculturalists speak about the fluctuations of certain crops as markets shift and detailed local distributions of weeds. People comment on plants with which they interact; their ability to recognize change is based on the various ways they were trained to see.

Perceptions differ geographically. Residents of Crowheart all remark on increases in wildlife along the Wind River, while no one downstream notes any change. Wealthy conservation buyers of larger parcels are perceived as newcomers in Crowheart, while Riverton immigrants are thought to prefer smaller subdivided lands. People in different parts of the basin list problems with different
invasive trees and weeds. Russian olive, for example, is discussed mainly by lower basin residents.

In addition to cultural and geographical differences, perceptions vary with scale of interpersonal interactions. When Lloyd D., for example, says, “there are some hard feelings between here and there” referring to water management on tribal and non-tribal lands and Don A. complains of the difference in the way the federal government treats Indian versus non-Indian farmers; when Ben W. remarks “the difference is I have to pay for my spray and they don’t” referring the provisions of chemicals to Indians and non-Indians to fight weeds and Geoff O. says, “people complain about all the tribal federal benefits, it’s amazing people can do that with a straight face when you look at the benefits that non-Indians have gotten from the development of this water” their perceptions infer differences that split on cultural lines. In contrast, John Washakie reflects on his childhood in Crowheart as “a time when we were all about the same financially and struggling” and Ralph Urbigkeit tells a story of being flat broke and borrowing from his Shoshone best friend. Likewise, when his friend needed to go to Lander to buy goods, Ralph U. would go with him, because Indians were often refused service in Lander at that time. Larger scale cultural differences do not always correspond to smaller scale interactions within communities. Perceptions differ with scale.
Perceptions Reflect Moral Geographies

Perceptions stem from strong belief systems. Basso’s words are worth restating; he writes that the complex affinities of sense of place, “are more an expression of community involvement than they are of pure geography, and its social and moral force may reach sacramental proportions, especially when fused with prominent elements of personal and ethnic identity” (1996, 148).

Three central perceptions of water reflect these moral forces. 1) Many area residents believe that water should be used to support human livelihoods. Lloyd D. expresses, “This land needs to be tilled. If not it looks like what you saw when you come over the hill. Looks like sagebrush. And what's that good for? It’s good for sage grouse and a few other things. It’s a good riparian area, but what’s it for? Antelope? But to make a living off of it and supply food for the world, it’s not gonna happen.” 2) Conservationists express a hands-off approach to the river. Berthenia C. says, “My ideal river is to take the dams out and let it rip. Let it do its scouring thing, its braiding thing and let it change channels the way it wants to. That would be my ideal river. Take Diversion Dam out and Boysen out.” Richard B. imagines a river where “we’d have a good flow of water going down the river in the canyon where all of that wildlife and aquifers and purification of water [so it’s] normal, natural, like it’s supposed to be.” 3) Rachel G. expresses a third point of view of water’s worth:

It’s here for life. It’s here not only for human life, but it’s here for Mother Earth and we consider that very sacred because it gives us life; it gives us all life and we respect that. We use it in our ceremonies and we want to cherish that water, that clean water,
and the rivers because we believe the Earth is our Mother and she’s the one that grows, and [growth] comes through the water. First of all, we consider it very sacred and we use it and we pray that we’re gonna still have water for our young children and for everybody else to eat and drink and grow and live and that includes our plants and our trees and our animals and just about everything in the universe, our snow, our four seasons. It takes care of all life, so we want to respect that.

These moral geographies are based on what Richard White calls “proper ways of life” again evidenced in the following contrasting points of view. Dave Skates, from a conservationist perspective, expresses:

This is sinful. This is unreal. I think, honestly, the reservation is what causes a lot of things to be done that wouldn’t be done otherwise... through the reservation, it’s sinful the way they operate. It wouldn’t be done [elsewhere], there would be group outcry if it were somewhere else in the country, even in Wyoming....Trout Unlimited, other people would go ‘you can’t do that’ but not on the reservation.

Dave S. adds, “You think that they would dry up the North Fork of the Shoshone River? You better not. The Miracle Mile? The South Fork? No, you better not.”

Scott R. adds, “You’ve got streams that could be, if not class one waters, then right up there for fisheries, all along the Wind [River] there. People would come unglued if that was somewhere else.” He describes the fluctuations on Bull Lake Creek, “One day it can be flowing 900 cfs and the next day 20. Would you do that to the Shoshone River, which is comparable to Bull Lake Creek? No. I tell you what, somebody’s butt would be in the frying pan...” In contrast Lars B. (as already quoted) says:

Game and Fish whine about irrigation and the function of the river. He swears we’re not getting cottonwood regeneration. The conditions are there. They’ll grow on gravel bars. The reason is the invasives. I don’t understand that issue: how we damned
the river and they don’t work right anymore. Without that diversion, none of these communities would look the way they do today. They’d be dry and droughty.

Conflict may be based more on moral geographies than individual issues. As Nancy Langston (2003, 162) explains, according to pragmatists, “Groups usually naturalize their own values, making them seem inevitable, God-given, and beyond the reach of discussion or change. People often find themselves unable to change such naturalized perspectives without abandoning what they see as part of themselves.” Of conflict over Columbia River water, Richard White (1995, 110) writes:

Fishermen see habitat. Irrigators see water. Power managers, utility operators, and those who run aluminum factories see reservoirs necessary to turn turbines. Barge owners see channels with certain depths of water. Environmentalists see brief stretches of free-flowing water. All stake a social claim to their part of the machine. None of them are concerned with the river as a whole.

It is notable that Richard B., quoted above, imagines a river “like it’s supposed to be.” Lloyd D. believes raising food is morally correct, and certainly Rachel G. believes water was created for all living things. Groups’ different viewpoints all hold an ethic that emphasizes ‘the way it’s supposed to be.’

Mobile Nature and Rural Mutualism

Mark Fiege (2005) suggests that forms of “mobile nature” such as weeds, water and organisms, challenge property boundaries. In a historical geography of weed management in rural Montana, he found, “Abstract divisions that separated one parcel of ground from another” enabled “efficient administration,
privatization, and control...in the service of capitalist production” but were porous when forms of mobile nature moved through fences. Mobile nature challenged private property boundaries. Montana farmers responded collectively to combat the spread of weeds, operating in what Fiege calls common geographic space, “a landscape defined less by linear divisions than by the shared experience of ecological connections.” Solutions to the weed problem exemplified “rural mutualism” and favored the collective over the individual.

Interviewees in the Wind River Basin perceived changes in several forms of mobile nature: game species, surface water, groundwater, weeds, and arguably climate patterns, which is certainly a form of ecological commons, but is globally, not locally, mobile. Reactions to mobile nature highlight the influence of perception in management of common geographical space. For example, interviewees expressed unanimous support for the changes that took place when the tribes established a game code in the 1980s. Likewise, interviewees generally supported some form of weed control, though some expressed concern over particular methods. Game and weeds are forms of mobile nature managed through rural mutualism in common geographic space. In contrast, methods of mediating contaminated ground water and distributing surface water are hotly contested at best and endlessly litigated at worst. Conflict is certainly exacerbated by the mobility of water, but mobility alone does not elicit conflict. Different perceptions of management cause clashes, not just the problem of mobility. Conflict arises when people perceive, in this case, the value of water differently. Mobile nature forces people, with their various perceptions, to interact.
Management of tribal lands further complicate Fiege’s discussion. Division of land according to abstract ownership lines turned into an administrative disaster as federal policy swung from privatizing land to preserving communal tribal lands (1880s to 1930s). Tribal interviewees often comment on the heirship headache resulting from this era that still encourages idle and leased lands. Abstract boundaries do not always promote “efficient administration, privatization, and control” that supports capitalistic production, even with non-mobile nature. “Control” of land is only effective when the intent of its residents is control. Irrigated agriculture is only effective when residents value irrigation and agriculture.

The social transformation necessary for rural mutualism requires recognition of a common problem, shared values, and a shared perception of its solution.

**Perception and Power**

Cultural assumptions underlie manifestations of power (Harris 1997) and power dynamics influence the ways perceptions shape place. Just as Fiege perceives human-environmental relationships operating in hybrid landscapes, Cole Harris suggests power operates in its own hybridization of power-place interactions. Harris writes (1991), “Social power is no longer conceived apart from its geographical context. Such power requires space, its exercise shapes space, and space shapes social power. The one cannot be conceptualized apart from the other; they exist in ongoing reciprocal interaction.”
Donald Worster conveys a more linear relationship, suggesting water flows toward power. He writes, “The hydraulic society of the West… is increasingly a coercive, monolithic, and hierarchical system, ruled by a power elite based on the ownership of capital and expertise” (1985, 7). Worster believes centralized power is “innately anti-ecological” (332). Langston notes, “Ideologies alone are rarely enough to impose order on landscapes and communities: managers also need power” (2003, 159).

Interviewees indicate that complicated power relationships influence the local environmental setting. Richard B., for example, exemplifies tribal power in the wildlife code:

The philosophy of managing wildlife on the Wind River reservation is not the same philosophy that the states or federal government or anybody else uses. The tribes and the Fish and Wildlife Service base it on the needs of the people, but more importantly, the populations of wildlife in certain areas… You know, we can always have good fishing on the reservation because it’s controlled by the tribes. And we can limit the number of people. And the same with hunting. It’s the best hunting in the world because only about 1000 tribal members hunt.

Tribes control wildlife management in the basin. Its management style is based on the specific needs and perceptions of the tribes, and thus has a unique fingerprint.

Interviewees recognize water management as a much more complicated power struggle between the tribes (which hold the oldest right), the state (which determines the way water can be used), and the federal government (which alone has the capital to develop infrastructure). Each power-holding institution
supports a certain perception of how water should be managed in the basin. River management favors certain perceptions over others as power changes hands.

For example, when D. Skates explains his perception of the power play that took place during the short period when tribes controlled water in the Wind River, he illustrates the relationship between shifting power and its implications for environmental change. Following the Bighorn Decree, before the state filed suit, Skates explains that in 1990 the tribes dedicated instream flow, “The state couldn’t challenge them that first year. It took them completely off guard. They didn’t know what they were gonna do.” The U.S. Fish and Wildlife helped the tribes stock fish and “ultimately, we paid the price… as a result, they shut down all stocking of fish for the [local] Fish and Wildlife Service.” The Service was then backed by the National Wildlife Federation, publicized by CBS and NBC, which “put it in the eye of the nation and thereafter because of the political heat, they allowed the Service to resume stocking fish.” When the tribes held power, river management favored instream flows. When the state filed suit, and regained power of the headgates, power returned to perceptions favoring agriculture.

Reba T. regrets:

We have to use our water for agriculture and nothing else. We could have an electrical plant, a water plant, even a recreation area, like a reservoir… We could have all that, because we’re first water users, but we’re not allowed to. So that’s a really bad thing. It’s not fair. You know, we have that right: the Bighorn decree. We have the rights but we’re not allowed to do anything.
In the Wind River Basin, as in Harris’s British Columbia, “issues of power characteristically turned on the control of land” and “life here was about occupying, controlling, and managing it, about establishing who could do what where” (Harris 1997, xiv). The same may be said for water. These power relationships leave environmental footprints.

Pragmatic Adaptive Management and Resilience

Nancy Langston (2003) and Donald Worster (1985) believe land is managed best when managed democratically. Worster writes, “a social condition of diffused power is more likely to be ecologically sensitive and preserving” (332). Likewise, Langston suggests that in addition to sound scientific practices, adaptive land management relies on “pluralism, multiple voices, and the formation of democratic communities” (156).

Langston does not envision, or value, land management without conflict. “The answer is not simply to give complete power to local communities but rather to institute a democratic process that creates a structure for useful conflict.” By working through this conflict, stakeholders moderate their points of view and learn to compromise. “For democratic processes to succeed,” Langston writes, “people need to be able to step out of their group’s constructed view of itself and its past, and to recognize the validity of other groups’ perspectives and values. They need to find a way to deconstruct their sacralized past with its sense of natural inevitability.” Langston calls this process “pragmatic adaptive
management” and though it can be painfully slow, “Burying differences only worsens them; hiding conflict only prolongs it” (165).

Alessa et al. (2008) add another dimension to the role of perception in environmental change. They suggest that the way people perceive environmental change is critical to their willingness and ability to respond to change. Furthermore, the difference between perception and the actual status of a resource “may be a determinant of resilience or vulnerability.” In other words, when unnoticed, change may accumulate to some kind of detrimental threshold that may impact the community and or resource. “Impaired knowledge means communities are less capable of responding to environmental changes because they do not detect them,” they write.

We can combine the fact that mediation of diverse perceptions may lead to better land management, and that resilience of cultures and ecosystems rely on perception. Democratic management that recognizes diverse perceptions may result in best management practices. The Wind River Basin may be managed best through strategies that incorporate its diversity of perceptions democratically.
This chapter examines a settlement corridor along the Wind River, a region bounded by Pleistocene terraces, which generally demarcate the region occupied by humans. The settlement corridor represents a subset of the larger region discussed in Chapter 2. Within the corridor, land use and land ownership varies; in places, marked differences are visible between checker-boarded tribal and non-tribal lands (Figure 4.1). The settlement corridor, and study area of this
chapter, is 170 km long, extending from just east of Dinwoody Creek to the mouth of the Wind River Canyon (Figure 4.2).

Figure 4.2 The study area of this research (in blue) extends from just east of Dinwoody Creek (upper left) to the mouth of the Wind River Canyon (upper right) and spans approximately 170 km.

The objectives of this chapter are twofold: 1) to better understand the physical dimensions of riparian change since 1948-1949, and 2) to investigate the relationship between land ownership and environmental change. Are riparian areas changing? Is there a relationship between complex land ownership patterns and environmental change? Do particular histories—and their underlying policies and economies—leave local, measurable, environmental fingerprints?

In order to examine measurable environmental change and heterogeneous geographies of change, I address two specific questions, formulated through interviews with 23 basin residents who expressed concerns about their changing environment: 1) have riparian forests decreased over the last sixty years, and is this decrease homogeneous over different geographical
areas and different ownership patterns, and 2) is rural development changing the settlement corridor and is it transforming land homogeneously? These questions examine broad landscape changes that relate to many expressed perceptions of riparian, agricultural and urban landscapes in the settlement corridor.

**Riparian Change along Western Rivers**

Riparian zones exhibit some of the most complex, diverse, and dynamic terrestrial habitat on the planet (Naiman and Decamps 1997) and play essential roles in western ecosystems. Riparian zones influence stream microclimates, maintain biological connections along environmental gradients, provide organic matter to organisms, filter and buffer streams from upland materials, preserve species richness with respect to natural disturbance, provide bank stability and decrease flooding, and ensure habitat and migration corridors for species dispersal (Wohl 2001; Knight 1994; Naiman and Decamps 1997). Knight (1994) suggests that people also tend to disproportionately settle near water, constructing cities, towns and roads in, or near, these zones.

An extensive and growing body of work discusses changes in native vegetation along Intermountain West and Great Plains rivers. Themes include downstream vegetation response to damming and diversion (Rood and Mahoney 1990; Johnson 1994; Kranjcec, Mahoney, and Rood 1998; Graf 1999; Friedman et al. 1998; Katz, Friedman, and Beatty 2005; Merigliano and Williamson 2007); the establishment and regeneration of cottonwood seedlings and saplings (Rood, Kalischuk, and Mahoney 1998; Cordes, Hughes, and Getty 1997); alluvial water
table declines and their impact on vegetation (Scott, Shafroth, and Auble 1999; Johnson et al. 1995; Williams and Cooper 2005); correlation of cottonwood establishment to flow patterns (Merigliano and Williamson 2007; Scott, Friedman, and Auble 1996; Auble and Scott 1998; Merigliano and Polzin 2003); the influences of natural disturbances as well as artificial disturbance on cottonwoods such as grazing (Auble and Scott 1998; Samuelson and Rood 2004), log floatways (Wohl 2001; Nilsson et al. 2005), and ice scour (Scott, Friedman, and Auble 1996); the proliferation of invasive species (Pearce and Smith 2001; Friedman et al. 2005); climate change (Rood et al. 2008; Friedman et al. 2005) and others.

As a dominant feature along regional rivers, cottonwoods are often examined to better understand fluvial process and their relation to floodplain vegetation. Due to their life histories, “cottonwoods serve as a clock” that indicates the age of a given floodplain and the time since a particular stand developed (Merigliano and Polzin 2003; Everitt 1968).

High peak flows strongly correlate with cottonwood regeneration (Scott, Friedman, and Auble 1996; Samuelson and Rood 2004, and others) and the relationship between flooding and cottonwood recruitment is well established; a single large flood may leave a vegetation legacy that dominates the landscape for decades (Katz, Friedman, and Beatty 2005). High flows serve two main purposes: 1) they distribute sediments well above normal flow levels, establishing the bare, moist sites protected from future water and ice scour and ideal for seedling establishment, and 2) they provide conditions in which water levels may
drop gradually as seedlings establish, ensuring moisture availability (Friedman, Scott, and Lewis 1995; Scott, Friedman, and Auble 1996; Auble and Scott 1998; Rood, Kalischuk, and Mahoney 1998; Mahoney and Rood 1998; Kalischuk, Rood, and Mahoney 2001). Aigeiros species (*P. deltoides* and *P. fremontii*) are perhaps more reliant on flooding because they do not readily produce clonally, as do Tacamahaca species (*P. balsamifera*, *P. angustifolia*) (Cordes, Hughes, and Getty 1997; Braatne, Rood, and Heilman 1996), though clonal propagation also correlates with flood events (Rood et al. 2003). On the Missouri River in central Montana, Scott et al. (1996) observed that 72% of cottonwoods established in the year of a flow greater than 1400 m$^3$/s or in the following two years. Kalischuk et al. (2001) noted extensive recruitment along mountain, foothills and prairie river reaches following a 1995 flood. Altered flow management practices that mimic historical flows have been shown to be effective in promoting recruitment (Braatne et al. 2007; Rood et al. 2005).

Declining water tables, damming, and water diversion relate to decreased cottonwood recruitment (Braatne et al. 2007; Scott, Shafroth, and Auble 1999; Graf 1999; Williams and Cooper 2005) as all three factors may interfere with conditions necessary for seedling establishment and declining water tables stress trees (Scott, Shafroth, and Auble 1999). In altered rivers, mature trees are commonly left as legacies of former flow regimes as few seedlings and saplings replace aging trees, and these trees may additionally display altered sex ratios (Braatne et al. 2007). Riparian forests downstream of dams have received particular attention because dams appear to correspond with cottonwood decline.
though some studies have found an increase in cottonwood regeneration as a result of river alteration (Johnson 1994; VanLooy and Martin 2005; Stromberg et al. 2010; Johnson 1998), in some cases because of channel narrowing and temporary increased availability of recruitment areas following damming and diversion (Johnson 1998). Dam effects depend on character and magnitude of adjustment (Katz, Friedman, and Beatty 2005) as well as particular river morphologies. For example, Johnson (1998) found that a braided stream supported woodland expansion and a meandering stream woodland decline. Cordes et al. (1997) recommend that regulated rivers should maintain the timing, duration and magnitudes of 1 in 5-year floods; one in ten-year floods; one in 50 year floods; and minimum flows during the ice-free seasons.

Invasive species have additionally contributed to native species decline, particularly Tamarix ramosissima (tamarisk) and Eleagnus angustifolia (Russian olive) now the third and fourth most frequently occurring woody riparian plants in the western U.S. (Friedman et al. 2005). Tamarisk infestation is more severe south of the 41st parallel, thriving in warmer conditions, while Russian olive is more successful further north, in cooler conditions (Friedman et al. 2005). Russian olive originated in southern Europe and western Asia and was transported to the Great Plains in the late 1800s, where it was planted in windbreaks and as wildlife habitat. It threatens to outnumber and even replace cottonwoods, especially along regulated rivers: it propagates through stem and stump sprouting and seed dispersal, its seeds germinate on vegetated and bare
surface, it is less palatable to livestock and less utilized by beaver than
cottonwoods, and it thrives in regulated systems (Pearce and Smith 2001).
Likewise, tamarisk often out-competes cottonwood trees because it is more
drought and salt tolerant and is known to spread voraciously, in cases up to 20
km/yr (Nagler et al. 2005). Both introduced species germinate under a wider
variety of environmental conditions than do cottonwoods (Pearce and Smith
2001; Katz and Shafroth 2003) however, tamarisk is less tolerant of inundation
than native species, and both species may be better controlled through flow
regimes that favor native species (Glenn and Nagler 2005; Katz and Shafroth
2003; Nagler et al. 2005). Some managers promote natural flows. They believe
that reducing the dynamic nature of a river system to regular flows is a human
caused disturbance that promotes invasive species. Others believe that re-
introducing a natural flow regime is not enough to combat invasive species
spread; invasive species require aggressive methods of eradication (Nagler et al.
2005).

Grazing has also been correlated with decreased cottonwood growth, and
Braatne et al. believe in many areas of the West, “the heaviest pressure on
riparian cottonwoods is related to livestock grazing” (Braatne, Rood, and Heilman
1996, 76). Cottonwood decline has been ascribed to browsing and trampling
(Kalischuk, Rood, and Mahoney 2001; Braatne, Rood, and Heilman 1996) as
well as less direct environmental changes including alteration of substrate
(Samuelson and Rood 2004) and increased erosion. Samuelson and Rood
(2004) found that, when compared to non-grazed areas, younger cottonwoods
display a “disturbed age structure.” A “healthy” cottonwood population displays a “punctuated progressive age structure” of many younger trees and progressively fewer older trees with pulses of seedling recruitment. Grazed stands display less recruitment pulses and lower tree and sapling densities. Auble and Scott (1998) suggest that livestock impacts may be most significant in flood years, when seedlings are most likely to establish, and less significant when seedlings are likely to be destroyed by other disturbance regardless of cattle grazing. Impacts are likely related to grazing intensities (Samuelson and Rood 2004).

Rood et al. (2008) suggest that Rocky Mountain headwater streams, draining from the Continental Divide, display several shifts related to climate change including increased winter flows, a more gradual spring rising limb of the hydrograph, an earlier spring peak, and declining summer flows. While increased winter flows are predicted to have little impact on riparian forests, spring alterations would throw off the coupling of plant phenology and flow regime, and decreased summer flows would cause considerable water stress. The authors thus predict fewer years of cottonwood recruitment, narrower bands of recruits, more area of unsuitable habitat, and greater susceptibility to already existing challenges (e.g. grazing and weeds). They cautiously predict flow declines of approximately 10 percent by 2050. Additionally, Friedman et al. (2005) suggest that climate change may lead to more suitable habitat for invasive species and expansion of tamarisk as winter temperatures increase. Merigliano and Williamson (2007) make an important note that older cottonwood forests may be
surviving legacies of past climate rather than indicators of current flow regimes and their human alterations.

Perhaps most importantly, as Stromberg et al. (2010) and Cordes et al. (1997) emphasize, riparian change is complex. Characteristics of particular rivers and their human legacies may leave heterogeneous patterns of change. Net effects can be different on different rivers, and even along the same river. Management efforts should consider myriad factors that include natural and cultural histories.

**Land Use Change Near Protected Areas**

Geographers and landscape ecologists have produced a second body of literature that strives to understand the way large ecosystem processes are affected by changing human preferences and settlement geographies.

Globally, population growth near protected areas often exceeds surrounding rural growth (Wittemyer et al. 2008; Wade and Theobald 2010) and threatens ecosystem function (Hansen and DeFries 2007). Protected areas attract human settlement and may do so for different reasons; while they provide protection from human conflict and offer bush meat in developing countries (Wittemyer et al. 2008), they provide recreation opportunities, second home sites, and wildlife viewing in developed countries (DeFries et al. 2007). Regardless of land use on surrounding lands, pressures affect preserves. Hansen and DeFries (2007) find that because protected areas are located within larger ecosystems, their population and disturbance dynamics often extend
beyond boundaries imposed by humans. Land use change outside a reserve may “rescale” the ecosystem, decreasing biodiversity and altering ecosystem processes. Reduced ecosystem size may result in the decline of recolonization sources and overall species richness, changes in seral stages related to disturbance, alteration of trophic structure, changes in airsheds and watersheds, the spread of exotic species and disease, and the decline of crucial habitats. To prevent these alterations, the authors call for established ecosystem boundaries and regional management that promotes the identification and preservation of vulnerable areas.

Discussions of growth and protected areas often focus on the western United States, where the amount of federal land and population growth exceeds other regions of the nation. Growth in the late 20th Century American West was extreme. In the 1990s the 11 western states grew by 10.2 million people, or 20 percent; Nevada, Arizona, Utah, Colorado and Idaho grew by 4.1 million people, collectively, an increase of 37 percent; and the trend is expected to continue. By 2030, Arizona and Nevada are expected to double, and Colorado, Utah and Idaho will add another one-third to one-half of their 2000 population (Travis 2007, 51). This growth has been even more extreme in the Greater Yellowstone Ecosystem, a term originally defined as the range of the grizzly bear (Craighead 1991) but expanded by Rasker (1991) and others to the jurisdictional boundaries of 20 counties encompassing this region. Gude et al. (2006) found that the GYE experienced a 58 percent increase in population between 1970 and 1999 and that the land area affected by rural residential development increased 350
percent. While 68 percent of the GYE is publicly owned (Gude, Hansen, and Jones 2007), privately owned lands are particularly vulnerable to growth. This growth disproportionally favors mountainous areas in counties attached to wilderness and areas near water and on highly productive soils (Rasker and Hansen 2000). Agricultural land and riparian areas are projected to experience highest rates of growth (Gude et al. 2006). The most significant reasons for locating in these areas are “the environmental and ecological amenities, the scenery, outdoor recreation, and the pace of life” (Rasker and Hansen 2000). Proximity to airports and the education level of the general population are also found to be significant (Rasker and Hansen 2000; Rasker et al. 2009). Retirees, wealthy young adults and professionals in service industries are said to be the newcomers and they often desire ranchette-style homes on large lots (Gude et al. 2006) that are available at relatively low costs compared to other regions of the country. “Nothing symbolizes the New West more than a mountain valley formerly used for livestock pasture and/or irrigated hay production, now punctuated with massive log homes perched upon the upper hillsides on parcels ranging anywhere between 10 and 160 acres” write Jackson and Kuhlken (2006, 29).

Despite the large body of work that explores New West human-environmental relationships across disciplines; several recent studies suggest that this analysis oversimplifies regional geographies. While many ecological and economic analyses acknowledge complexity in “natural” systems and linked human-environmental systems—including non-linearity, thresholds, and time lags
(Liu et al. 2007; Theobald 2004)—they tend to overlook the complexity of human communities and the way this complexity shapes place. Bryson and Wyckoff (2010), for example, illustrate the ways different cultural notions of nature and flows of regional capital shape two geographically similar Montana communities in very different ways. Robbins et al. (2009) draw similar conclusions: shifting flows of capital are volatile and have the potential to rapidly transform communities heterogeneously. Robbins et al. additionally argue that “new” and “old” Wests are misleading terms that invite polarization: newcomers and old-timers are not always at odds, newcomers do not always display more sustainable practices on their ranches and ranchettes, and the multiethnic character of the West still influences the region heterogeneously (see also Paveglio et al. 2009; Winkler et al. 2007). They suggest we complicate our questions: “the empirical question may not be ‘do newcomers and old timers differ?’ but instead ‘what cultural-economic differences exist among the residents of dynamic exurban spaces, and what processes produce, maintain, or erode those cultures and differences?’” and not “‘what are the relative merits of local versus non-local control?’ but also ‘at what scales do power and decision making converge, and what determines or constructs the ‘appropriate’ scale for decision making under divisive political conditions?’” Just as ecological systems display thresholds, lag times, and nonlinearity, human systems are inherently complex.

Finally, and perhaps most importantly, many studies of regional change focus on human-environmental relationships since 1970 and overlook the influences of a hundred years of permanent settlement history as well as prior
Native American histories. A deeper understanding of historic human-environmental relationships is not only necessary for an understanding of specific impacts (e.g. the lasting legacies of 20th Century grazing practices and mining, see Wyckoff and Hansen 1991; Wohl 2001); it is essential for a broader understanding of 20th Century human-environmental relationships as a whole. Rather than recognizing a sudden period of growth as a unique environmental problem, for example, historical perspectives might encourage a broader examination of the environmental influences of capitalism as a whole. Solutions to environmental problems may not be possible without this larger lens.

The call to complicate the New West narrative is relevant to GYE discussions. While riparian areas near the borders of wilderness areas may be more vulnerable to rural residential growth, certain areas may be exempt. These may involve regional planning efforts that prevent growth (Travis 2007, 179-241; Jackson and Kuhlken 2006, 231-249) but are more likely tied to complicated human geographies and cultural preferences. Reservations, perhaps the most notable example in the GYE, operate under strong local jurisdiction that makes growth in certain areas impossible. Conversely, certain areas may be more vulnerable. Winkler et al. (2007) find that “New West” communities are spatially concentrated in certain locales, including the eastern and western slopes of the Rockies, with fewer “New West” communities on the plains. GYE vulnerabilities may be better assessed through more complicated questioning.

“New West” research in the GYE has been valuable and essential. It encourages a proactive approach to ecosystem management, identifies
vulnerabilities (Noss et al. 2002; Gude et al. 2006), and recognizes that an understanding of linked human-environmental systems is essential in conservation efforts. The addition of more historical and multiethnic perspectives promises to make this field of research more robust, in the GYE, the West, and other protected ecosystems. The following research strives to contribute to this broader work.

Study Area

The Wind River flows from its headwaters on Togwotee Pass southeast to the junction of the Wind River and Little Wind Rivers, where it turns northward, enters the Wind River Canyon and becomes the Bighorn River. This study investigates a 170 km portion of the river from just east of Dinwoody Creek to the mouth of the Wind River Canyon (Fig 4.2).

This work focuses on cultural geographies of the vegetative mosaic, which are diverse. Generally, Eastern Shoshone people live on the western portion of the study area (above the Diversion Dam), Northern Arapaho live downstream toward Riverton, and non-Natives live throughout the study area, though these categories are generalizations, and not at all exclusive. Land ownership consists of tribal lands, allotted lands, fee lands, and various government lands. While residents recognize several dispersed communities along the river, the only substantial urban area is the town of Riverton, population 10,000.

Agricultural vegetation, native vegetation, and grazing lands are valued throughout the study area by basin residents. Agriculturalists west of Morton
Lake produce hay, while those downstream grow additional row crops such as pinto beans and sugar beets. Plants of cultural significance to the Shoshone and Arapaho peoples include many prominent riparian species: cottonwoods, willows, buffaloberry, chokecherry, and currants in addition to myriad herbaceous plants. The study area transitions from higher to lower elevation cottonwood forests as it moves downstream, \((P. \text{balsamifera}, P. \text{angustifolia} \text{ to } P. \text{deltoides}, P. \text{angustifolia})\) though species overlap; \(P. \text{deltoides}\), for example, is found along Bull Lake and in plantings near Dinwoody Creek.

Flows in the Wind River are controlled by tributary reservoirs as well as diversion structures on the main stem. Dams control water held in Dinwoody and Bull Lake Reservoirs, which drain through Dinwoody Creek and Bull Lake Creek into the Wind River. The Diversion Dam diverts water from the Wind River through the Wyoming Canal to the Riverton Irrigation Project and several smaller diversion structures funnel water to ditches.

This study divided the 170 km stretch of river into five different geographical areas: Dinwoody Creek to the Wind River Diversion Dam (GA1), the Diversion Dam to Riverton (GA2), Riverton to Muskrat Creek (GA3), Muskrat Creek to Boysen Reservoir (GA4), and Boysen Reservoir to the Wind River Canyon (GA5) (Figure 4.3). Divisions were based on a combination of cultural areas and obvious land use divisions.

GA1 begins just east of Dinwoody Creek. Its westernmost extent was defined by the extent of photo coverage available in 1948-1949. Its easternmost extent was defined as the Diversion Dam, an important landscape feature both
ecologically and historically. This region is characterized by disparate populations and the communities of Burris, Lenore, and Crowheart. It is generally inhabited by Eastern Shoshone and non-Native residents. Riparian areas are dominated by cottonwood forests, extensive in places, and supported by glacially-fed tributary creeks.

GA2 is bounded by the Wind River Diversion Dam on its westernmost end, extending downstream to its easternmost boundary, the Riverton Area, defined by its much denser human settlement patterns than GA2. It is affected by water diversion from the Diversion Dam, and defined by its rural habitation patterns. Its riparian forests are dominated by cottonwoods and increasing amounts of Russian olive in downstream reaches.

GA3 is the Riverton Area, which exhibits denser habitation patterns than its upstream and downstream geographical areas. Development is more dispersed on its outskirts, and densely populated in the city center. Riparian areas are affected by factors that differ from other geographical areas, including a golf course, industrial areas, and dense development. Cottonwoods are interspersed with Russian olive, and the settlement corridor displays a mixture of agricultural lands and urban lawns.

GA4 is bounded on its southernmost extent by the last set of cluster houses in the Riverton Area. It extends northward to Muskrat Creek, an obvious landscape feature south of the area affected by Boysen Dam. This area is dominated by cottonwood forests with extensive areas of Russian olive, in places.
GA5 is defined as the area affected by Boysen Dam and reservoir. Most of it consists of reservoir waters. It thus displays a different ecological mosaic, with very few cottonwoods, and increasingly more tamarisk.

Figure 4.3 Geographical areas of the Wind River corridor. 1-Dinwoody area to the Diversion Dam, 2-Diversion Dam to Riverton area, 3-Riverton area, 4-Riverton area to Muskrat Creek, 5-Muskrat Creek to the Wind River Canyon.

**Methods**

Both riparian change and growth patterns were assessed through analysis of 1948-1949 and 2006 aerial photography pairs as well as several sets of repeat photography images. Historic aerial photographs (scale 1:23,600, scanned at 1000 dpi) were acquired from the USGS. Each of 73 images was georeferenced with 2006 NAIP imagery in Arcmap, using a minimum of 15 control points. The
root mean square error (RMS) was less than 3, using 2nd and 3rd order polynomial transformations.

In order to estimate riparian and growth pattern using aerial photos, it was important to ensure either that the images were not highly distorted, or if highly distorted, that the distortion was consistent between the historic and modern images. Inconsistent levels of distortion could lead to false conclusions if, for example, a forested area of fixed size comprised a considerably higher percentage of the composite historic image than the composite modern image. In order to assess differences in distortion between the historic and modern images, nine sample areas, easily identified in both images from landmarks (e.g. roads) were selected. These reference areas varied appreciably with respect to distance from the image edge (Figure 4.4) because the degree of distortion tends to be greater near image edges.

Figure 4.4 Reference areas for assessing distortion. Nine reference areas were selected in various locations in the study area, and compared to assess the extent of distortion.
A 20 m grid was projected over the reference areas in both the 1948/49 and 2006 images, and the number of grid cells covering these areas was counted. The numbers of grid cells in the historic and modern images were nearly identical for every area, so image distortion did not greatly influence the conclusions of this study (Table 4.1).

Table 4.1 Estimated imagery distortion in reference areas. Grid cells projected over reference areas (E1-E9) were counted in 1948/49 and 2006 images (column A) and calculated as ratio 2006/1948-49 (Column B). A measurement from the nearest edge of the 1948/49 photograph the center of each reference area (Column C, in meters) was taken. Distortion was not found to be significant.

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>1948</th>
<th>Ratio</th>
<th>Measurement (in meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>612</td>
<td>612</td>
<td>1</td>
<td>1970</td>
</tr>
<tr>
<td>E2</td>
<td>178</td>
<td>172</td>
<td>1.034883721</td>
<td>1950</td>
</tr>
<tr>
<td>E3</td>
<td>107</td>
<td>106</td>
<td>1.00943962</td>
<td>1280</td>
</tr>
<tr>
<td>E4</td>
<td>371</td>
<td>373</td>
<td>0.99463807</td>
<td>1312</td>
</tr>
<tr>
<td>E5</td>
<td>561</td>
<td>562</td>
<td>0.998220641</td>
<td>1840</td>
</tr>
<tr>
<td>E6</td>
<td>441</td>
<td>430</td>
<td>1.025581395</td>
<td>723</td>
</tr>
<tr>
<td>E7</td>
<td>230</td>
<td>223</td>
<td>1.031390135</td>
<td>426</td>
</tr>
<tr>
<td>E8</td>
<td>125</td>
<td>120</td>
<td>1.041666667</td>
<td>681</td>
</tr>
<tr>
<td>E9</td>
<td>966</td>
<td>967</td>
<td>0.998965874</td>
<td>960</td>
</tr>
</tbody>
</table>

The width of the study area differed between analysis of riparian change and development; while the Pleistocene terraces bounded the area established for assessing development, a narrower area was delineated for riparian change,
so as to exclude lands without riparian forest in both the 1948-1949 and 2006 images, which were irrelevant to research questions (Figure 4.5).

Figure 4.5 Depiction of two study areas. The study area for riparian change is depicted in light blue, the study area for rural development in dark blue.

Ten 300 ha areas within the settlement corridor were groundtruthed during the summer of 2009 and vegetation polygons were adapted from Merigliano and Polzin (2003) (Figure 4.6). Categories were adjusted to better represent vegetation distributions of the Wind River as well as more specific categories for human settlement patterns. For a number of reasons, these categories were collapsed to two main categories: riparian forest or non-forest. Point sampling and grid sampling were used rather than polygon comparison because: 1) boundaries of polygons could not be confidently distinguished in georeferenced photographs, 2) polygons do not account for forest thinning, which is significant and, 3) results of interviews with 23 basin residents suggested that broad concerns could better be answered through different methods.
Figure 4.6 Vegetation polygons. Polygons were created by ground-truthing a 300 hectare portion of the settlement corridor. These categories were collapsed to 0: no riparian forest and 1: riparian forest.

Riparian Change

In order to assess riparian change, 995 points were randomly sampled from the study area and recorded as forested or non-forested at a scale of 1:3000. If any trees were present within 20m of the sample points, they were classified as forested (Figure 4.7). The 1948/49 points and 2006 points were then analyzed as two separate samples; the points between time periods were not treated as pairs.
Points were analyzed by geographical area (GA1-GA5, and 177, 247, 245, 119, and 207 points respectively), to determine differences in change within this 170 km stretch of river. Finally, in order to investigate the relationship between land ownership and changes in riparian forest, a Bureau of Indian Affairs land ownership layer was projected over the study area, and points were then classified by land ownership category: allotted (A), tribal (T), fee (F) and withdrawn (W) lands (Figure 4.8). Allotted lands are lands that were originally distributed to individual tribal members or families under government policy spanning 1868-1934 on the Wind River Reservation. While many were sold prior to 1934, they cannot now be sold to non-tribal members. Tribal lands are lands held and managed jointly by the tribes. Fee lands are lands that have been alienated from the reservation. They are private lands, owned and managed by
individual native or non-native owners. Withdrawn lands refer to lands withdrawn from the reservation as part of the Riverton Project (1906) as well as Boysen Reservoir (1950). Lands referred to as “all tribal lands” (AT) refer to allotted and tribal lands combined. Lands referred to as “all alienated” (AA) refer to fee and withdrawn lands. Points that fell on water as defined by the BIA layer were discarded.

Figure 4.8 Land ownership layer. A Bureau of Indian Affairs ownership layer was projected over the study area. Ownership categories were compared with riparian change.
Urban and Rural Development

In order to assess rural residential and urban development, its spatial patterns, and land ownership relationships, a 200m grid was projected over the broader 170 km study area, the settlement corridor bounded by Pleistocene terraces (Figure 4.9). From this grid, 1313 randomly selected grid squares were analyzed and number of buildings in each square was recorded in 1948/49 and 2006 images.

![Image](image.jpg)

Figure 4.9 Analysis of number of buildings. Red areas represent 200 m grid squares randomly selected over the study area and then assessed for number of structures present.

Grid squares were then analyzed spatially and by land ownership, as described for riparian change (Figure 4.7, Figure 4.8). Each geographical area, GA1-GA5,
contained 158, 308, 356, 265, 226 points, respectively. Changes were analyzed as the difference in number of buildings in each selected square.

Data were analyzed using a bootstrap procedure (Efron and Tibshirani 1993). With respect to forest analysis, 995 cells were sampled in both the historic and modern images: the percent of forested cells in the 1948/49 images was subtracted from the percent of forested cells in the 2006 images. This sampling and calculation took place 10,000 times. The point estimates and 95% confidence intervals were then calculated from the quantiles of the samples. Similarly, the development analysis was performed with a bootstrap procedure in which 1323 points were sampled. Percent change was based on the difference in numbers of structures in each grid cell.

Results

Changes in Riparian Areas

According to the point estimate, the riparian study area displayed an overall average 18 percent decrease in riparian forest. According to the 95 percent confidence interval, all trees declined between 13 and 21 percent. When GA5 is excluded, due to the effects of Boysen Reservoir, the point estimate indicates a 7 percent decrease in riparian forest, with a confidence interval displaying 3 to 12 percent declines. The geographical distribution of change varied: a 15 percent decrease from the Dinwoody area to Diversion Dam (GA1), a 10 percent decrease from Diversion Dam to Riverton (GA2), a 5 percent increase in the Riverton area (GA3), a 14 percent decrease from Riverton to
Muskrat Creek (GA4) and a 56 percent decrease from Muskrat Creek to the mouth of the Wind River Canyon (GA5) (Figure 4.10).

![Percent Change in Riparian Forest: 1948-2006](image)

Figure 4.10 Forestation in different geographical regions. Point estimates (dots) and 95 percent bootstrap confidence intervals (bars) describe changes in the extent of forestation in different geographical regions along the Wind River between 1948/49 and 2006.

Change in the extent of riparian forest was relatively similar among allotted, tribal and fee lands, but dramatically differed on withdrawn lands (Figure 4.11). According to the point estimate, allotted lands decreased by 4 percent, tribal lands by 8 percent, fee lands by 9 percent, and withdrawn lands by 47 percent. All tribal lands (AT), which includes allotted and tribal, decreased by 6 percent. All alienated lands (AA), which includes fee and withdrawn, decreased by 27 percent.
Figure 4.11 Percent forest change as it relates to land ownership. Point estimates and 95 percent confidence intervals describe percent change according to land ownership. AT refers to All Tribal lands (allotted and tribal) and AA to All Alienated lands (fee and withdrawn).

**Changes in Development**

According to the point estimate, numbers of human structures increased overall by 77 percent; all but one geographical area displayed increase (Figure 4.12). The 95 percent confidence interval indicated a range of 55 to 102 percent change. When GA5 is excluded, due to the obvious effects of Boysen Reservoir, the point estimate indicates a 93 percent increase, and the confidence interval a 66 to 122 percent range. According to point estimates, GA1 increased by 4 percent, GA2 increased by 6 percent, GA3 increased by 260 percent, GA4 increased 25 percent, and GA5 (the Boysen Dam area) decreased by 1 percent.
Figure 4.12 Changes in human structures. Point estimates and 95 percent confidence intervals describe changes in the number of human structures between 1948/49 and 2006.

The relationship between land ownership and development displayed similar trends on allotted, tribal and withdrawn lands, but differed from fee lands (Figure 4.13). Point estimates indicate that allotted lands increased by 8 percent, tribal lands by 3 percent, fee lands by 170 percent, and withdrawn lands by 1 percent. All tribal lands (AT), which includes allotted and tribal, increased by 6 percent. All alienated lands (AA), which includes fee and withdrawn, increased by 110 percent.
Figure 4.13 Changes in structures as related to land ownership. Point estimates and confidence intervals describe the relationship between development and different types of land ownership along the Wind River.

**Discussion**

With respect to overall riparian forest and development, the Wind River settlement corridor is changing. Heterogeneous patterns of change relate to both geographical distribution and land ownership.
Geographical Area 1:

Figure 4.14 Location map of GA1 imagery. Images used in this section are marked 1-3 and a-d. The extent of GA1 is outlined in blue. Aerial photography pairs (1948/49 and 2006) are numbered 1-3; repeat ground rephotography a-d, and the USGS Crowheart gage is marked with a yellow point.
Point estimates for GA1 (Figure 4.14) indicated a 15 percent decrease in riparian forest between 1948-1949 and 2006 (Figure 4.15) with similar changes on tribal and non-tribal lands. The number of structures did not change significantly in this area (Figure 4.16).
According to point estimates, the extent of riparian forest decreased 15 percent in GA1.

Changes in human structures were not significant in GA1 according to point estimates.
Despite its 15 percent change, this zone has changed less than any other in the area in both extent of riparian area and development. It has few Russian olive and tamarisks, often displays a variety of cottonwood age classes and stream fluctuation, and (aside from the decade 2000-2009) has seen little change in its hydrograph since the 1940s (Figure 4.17).

Figure 4.17 Wind River hydrograph, USGS Crowheart gage. The hydrograph displays little change in decadal average flows between 1940 and 1999, but decreasing flows in the 2000-2009 period.

In a series of comparison aerial photographs (1948-1949 and 2006) declining cottonwood forests are visible, in the extent of riparian vegetation and in forest thinning (Figure 4.18-Figure 4.20). In a series of ground rephotographs, changes are less evident (Figure 4.21-Figure 4.24); the vegetative mosaic
displays a variety of cottonwood age classes, diversity in riparian shrub, no Russian olive or tamarisks, and stream fluctuations characteristic of cottonwood recruitment (Figure 4.25 and Figure 4.26).

Declines in riparian forest may be related to a variety of factors discussed in regional literature concerning riparian change. Historic cattle and sheep grazing, for example, may have contributed to declines in cottonwoods, willows, and other riparian species. Excessive grazing in the first decades of 20th Century is well documented in historical records, and still recalled by older local residents (R. Urbigkeit, personal communication, 2010). Grazing regulations were not enforced until the 1930s. While 1948-1949 photographs were taken after the era of extreme overgrazing ended, the mature forests they depict may have developed several decades earlier, prior to grazing pressures. Later in the 20th Century, when livestock regulations relieved grazing pressures, additional grazing pressures may have developed after the tribal game code was passed in the 1980s. Local residents and the U.S. Fish and Wildlife Service note dramatic increases in deer and elk along the river following the establishment of hunting regulations. In sum, decreases of riparian forest depicted in 2006 photos may not just represent current practices, but also legacies of historic grazing trends.

Cattle raising, and related hay cultivation, has continuously remained a central part of lifestyles and livelihoods in this area since the early part of the 20th century, and deer and elk have been reestablished as part of the accepted fauna.

Alteration in flow regimes has been correlated with declines in cottonwood forests. While flows have changed in GA1, the dynamics of change differ from
those in downstream riparian areas, relating more to climate than damming and diversion. Moreover, the changes of these specific flows may play an increasingly important role in changes of the vegetative mosaic of the upper basin. Two dams regulate flows on Dinwoody Creek and Bull Lake Creek, tributaries to the Wind River, though no dam or major diversion affects the main stem of the Wind River in GA1. Gage data does not predate the construction of the Dinwoody or Bull Lake Dams, making the impact on overall flows difficult to discern in Wind River hydrographs. Fluctuations may have taken place prior to the 1940s, but no significant changes are evident in this 50-year period.

In contrast, decreased flows in 2000-2009 represent a decade of drought in Wyoming (Wyoming State Climate Office 2010) and highlight more current discussions on climate change in this portion of the Wind River Basin.

Gannet Glacier and Dinwoody Glacier, two of the largest glaciers in the western United States, are part of a well documented glacial complex of 63 glaciers in the Wind River Mountains, the largest concentration of glaciers in the American Rocky Mountains (Cheesbrough et al. 2009). These glaciers, which drain to the Wind River in GA1, are diminishing. Cheesbrough et al. (2009) found that the 41.2 km² area (+- 11.7 km²) covered by these glaciers in 1961 decreased 20% by 2005, and smaller glaciers lost more area than larger glaciers. While some scenarios predict a complete loss of glaciers in this region within 20 years (Marston et al. 1991; Wyoming Water Development Office 2003), others suggest that variability in climatic cycles makes this time frame difficult to predict.
centuries, for example, and the 20th Century may have been particularly wet (Watson et al. 2009). Regardless, glacial melt significantly influences Dinwoody Creek, Bull Lake Creek, and the Wind River. Cheesbrough et al. (2009) estimate that 4-10 percent of July-October stream flows in both Dinwoody and Bull Lake Creeks originate from glaciers; Marston et al. (1991) estimate that 3 percent of June and 30 percent of October flows are composed of ice melt in Dinwoody Creek.

If, as Marston et al. (1991) and Cheesborough et al. (2009) predict, water uses become increasingly strained in the Basin, the mosaic of both agricultural and riparian vegetation, and their relationship to one another, could again shift.
Figure 4.18 GA1 aerial photo pair 1. Photo pair displays areas of riparian forest in 1948/49 (top) that have thinned and decreased in extent by 2006 (bottom). Red circles represent areas of most noticeable change.
Figure 4.19 GA1 aerial photo pair 2. Photo pair exhibits riparian woodland decrease between 1948/49 (top) and 2006 (bottom). This region is fed by glacial melt from the Wind River Mountains.
Figure 4.20 GA1 aerial photo pair 3. Photo pair displays woodland decline between 1948/49 (top) and 2006 (bottom). While some areas show expansion of cultivated lands, most of the region’s cultivated lands were already established by 1948/1949.
Figure 4.21 GA1 repeat photo pair “a.” Portions of GA1 appear to have changed very little in the Crowheart area, taken August, 1883 (top) and July 2007 (bottom). Original photo by F. Jay Haynes as part of President Arthur’s Journey through Wyoming, courtesy of Denver Public Library.
Figure 4.22 GA1 repeat photo pair “b”. Image of the Crowheart area taken approximately 1936 (top) and July 2007 (bottom) display a similar vegetative mosaic.
Figure 4.23 GA1 repeat photo pair “c”. Image of Crowheart Butte taken 1936 (top) and July, 2007 (bottom) depicts the sinuosity of the Wind River near Crowheart and the way riparian vegetation relates to river fluctuation over time.
Figure 4.24 GA1 repeat photo pair “d”. Image looks upstream from the Diversion Dam at railroad ties during the Wind River tie drives (approximately 1940, top), and at a colonized sediment bar (July, 2007, bottom).
Figure 4.25 July, 2009 photo of GA1 upstream of Crowheart depicts a mixture of age classes, and no tamarisk or Russian olive.

Figure 4.26 July, 2009 photo of riparian forest upstream of Crowheart.
Geographical Area 2

Figure 4.27 Location map of GA2 imagery. The extent of GA2 is outlined in blue. Aerial photography pairs (1948/49 and 2006) are numbered 1-4; repeat ground rephotography a-c, and USGS gage marked with yellow point.

Point estimates indicate that Geographical Area 2 (GA2) (Figure 4.27) experienced a 10 percent decrease in riparian forests between 1948-1949 and 2006 (Figure 4.28), with no clear differences between tribal and non-tribal lands (Figure 4.29). The number of human structures increased six percent, increasing with proximity to Riverton (Figure 4.30), disproportionately on non-tribal lands (Figure 4.31). Riparian change increases with proximity to Riverton. Aerial photos indicate more Russian olives, areas of more intensive and expanded agriculture, and greater human occupancy than in areas upstream.
Figure 4.28 GA2 change in riparian forest. Extent of riparian forest declined 10 percent from 1948/48-2006 according to point estimates.

Figure 4.29 GA2 change in riparian forest with respect to land ownership. Changes in riparian forest display little relationship to land ownership.
302

Figure 4.30 GA2 development change. Number of human structures increased with proximity to Riverton.

Figure 4.31 GA2 development change with respect to land ownership. Development displays a close relationship to non-tribal lands.

The vegetative mosaic downstream from the Diversion Dam is changing.

In addition to the 10 percent decline in riparian forest, Russian olive has replaced
areas formerly inhabited by cottonwoods, and has colonized areas which formerly had no forest. The spread of Russian olive and decline in cottonwood forests is likely the product of several factors, which (in addition to species introductions related to erosion control and wind breaks) may include grazing, altered flows, and a century of settlement history focused on agricultural settlement and irrigation.

GA2 has been heavily influenced by irrigation; an extensive network of canals waters agricultural lands. The flow regime also has changed. While records of the stream gage near Kinnear are incomplete (they begin in 1974, exclude the 1980s, and only record April through September flows), the shape of the post 1974 hydrographs can be compared with a downstream gauge near Riverton, which recorded pre-irrigation data (Figure 4.32 and Figure 4.33). USGS Kinnear gage hydrographs depict lower flows as water levels rise in spring, and a more dramatic earlier recession. These patterns are typical of hydrographs representing flow-altered streams. Gradual flow decline after peak flows is particularly important for cottonwood and willow recruitment; it allows seedlings to maintain contact with moisture as flows recede (Rood et al, 2005). In some cases, damming and diversion impedes that process. While Bull Lake Dam and Dinwoody Dam regulate tributary flows, the Diversion Dam spans the width of the Wind River, draining water into the Wyoming Canal (Figure 4.34).

Aerial rephotography displays decreases in riparian areas in extent and density (Figure 4.35-Figure 4.37) which may relate to water diversion from the
Diversion Dam, flow alterations and the effects of other drainage canals (Figure 4.38-Figure 4.40).

Figure 4.32 Kinnear gage hydrograph. Flows from 1974-2009 are depicted by decade and include all available dates (April through September).

Figure 4.33 Riverton hydrograph. Downstream Riverton hydrograph displays pre-altered flows (January through September).
Figure 4.34 GA2 aerial photo pair 1. Paired image (1948/49, top, and 2006, bottom) depicts riparian areas downstream of Diversion Dam, center left and the Wyoming Canal, upper center.
Figure 4.35 GA2 aerial photo pair 2. Image depicts riparian forests declining in extent and density in GA2 (1948/49, top, and 2006, bottom).
Figure 4.36 GA2 aerial photo pair 3. In pair 3 (1948/49, top and 2006, bottom) agricultural lands display little change, but riparian forest has decreased.
Figure 4.37 GA2 aerial photo pair 4. Photo pair 4 displays additional agricultural clearing between 1948/49 (top) and 2006 (bottom) and decrease in riparian forest.
Figure 4.38 GA3 repeat photo pair “a”. Pair “a” (approximately 1940, top, and July, 2006, bottom) looks downstream from the Diversion Dam, Russian olive is apparent in a windbreak and scattered among cottonwoods and willows.
Figure 4.39 GA2 repeat photo pair “b”. Pair “b” (approximately 1940, top, and 2006, bottom) depicts the Diversion Dam and surrounding area to the south.
Figure 4.40 GA2 repeat photo pair “c”. Looking downstream from the bluffs above the Diversion Dam, photo pair “c” (approximately 1940 and July, 2006) displays some attrition in cottonwoods below the dam.
Geographical Area 3

Figure 4.41 Location map of GA3 imagery. Images used in this section are marked 1-8 and a-d. The extent of GA3 is outlined in blue. Aerial photography pairs (1948/49 and 2006) are numbered 1-8; repeat ground rephotography a-d, and USGS Riverton gage is marked with a yellow point.

Geographical Area 3 (GA3) (Figure 4.41) encompasses the Riverton Area and includes a denser pattern of development that differs from upstream and downstream areas. According to point estimates, between 1948/49 and 2006, riparian forest increased five percent (Figure 4.42), and development (as defined by change in the number of structures) increased by 260 percent (Figure 4.43).
Figure 4.42 GA3 change in riparian forest. According to point estimates, riparian forest increased between 1948/1949 and 2006, particularly in the floodplain between the Wind and Little Wind Rivers.

Figure 4.43 GA3 change in development. The number of structures increased dramatically in the Riverton Area between 1948/1949 and 2006 according to point estimates.
Figure 4.44 GA3 change in riparian forest with respect to development. Riparian forest change has taken place on both tribal and non-tribal lands.

Riparian forests in GA3 have been transformed more than any other upstream region on both tribal and non-tribal lands (Figure 4.44). Russian olive and tamarisk are abundant in certain areas, declines in cottonwood forest are dramatic in places, and industrial and residential development is taking place on riparian areas. The five percent increase in riparian forest is attributed to spread of Russian olive in formerly unforested areas, not proliferation of cottonwoods and willows.

Stream gages record dramatic decreases in flows over the 20\textsuperscript{th} century beginning with the establishment of irrigation for the Riverton Project. Peak flows in the 1980s were approximately one third of those in the 1920s; and the
receding limb of the post-irrigation hydrograph occurs earlier and more abruptly (Figure 4.45).

Figure 4.45 Hydrograph of the USGS Riverton gage. Flows are depicted by decade from 1920-2009.

Increases in development are dramatic and reflective of New West trends (Figure 4.46). Suburban development and rural residential development are both increasing (Figure 4.47-4.51), and both are closely correlated with non-tribal lands (Figure 4.46). The population of Riverton grew from 4142 to 9310 between 1950 and 2000, or 45.4 percent; and in the same time period Fremont County grew from 19,580 to 35,804, or 54.7 percent.
Figure 4.46 GA3 change in development with respect to land ownership. Increases in structures, reflective of overall development, have taken place disproportionately on non-tribal lands.

The increase in Russian olive over the past several decades is dramatic and accounts for the five percent increase in riparian forest in this zone. Its spread is particularly notable between the Little Wind River and Wind River upstream from their junction (Figure 4.51 and Figure 4.52). As seen in Figures 4.53 and 4.54, riparian forest downstream from Riverton has dramatically declined, particularly cottonwood forest. Tamarisk is present and increasing in many areas of GA3, and is expected to become more problematic over time (U.S. Fish and Game, personal communication, 2010).

Contrary to the two rivers’ names, the Wind River sometimes carries very little water at the junction of the Wind and Little Wind Rivers (Fig 4.53). Because
flow alteration is more likely to affect cottonwoods than other trees, flow changes may relate to cottonwood decline and increase of Russian olives and tamarisks.

GA3’s riparian areas serve myriad purposes. The settlement corridor is used industrially (Fig 4.53 and 4.55), for grazing (Figure 4.56), amenity purposes such as golf courses and large homes on large lots (Figures 4.48, 4.50 and 4.57) and even for big box stores (Figure 4.58).
Figure 4.47 GA3 aerial photo pair 1. Image depicts the Riverton Area and suburban growth between 1948/1949 (top) and 2006 (bottom).
Figure 4.48 GA3 aerial photo pair 2. Image depicts increases in rural residential development upstream from Riverton (1948/49, top, and 2006, bottom).
Figure 4.49 GA3 aerial photo pair 3. Image depicts development spreading upstream from Riverton into agricultural lands. Russian olive has visibly spread into lands unforested in 1948/49 (top) and 2006 (bottom) in the lower left of the images.
Figure 4.50 GA3 aerial photo pair 4. The north side of the river has been transformed (1948/49, top and 2006, bottom) from agricultural lands into high end residential homes on a golf course in photo pair 4. Lands north of the river are non-tribal lands; lands to the south are tribal and allotted lands.
Figure 4.51 GA3 aerial photo pair 5. image depicts a closer view of Russian olive proliferation on formerly unforested lands (1948/49, top, and 2006, bottom).
Figure 4.52 GA3 aerial photo pair 6. Image depicts a different region of Russian olive proliferation between 1948/49 (top) and 2006 (bottom) in areas where few trees existed in 1948/49.
Figure 4.53 GA3 aerial photo pair 7. Red circle depicts the junction of the Wind River (upper river) and the Little Wind River (lower right). Note extensive decrease in riparian forest between 1948/49 (top) and 2006 (bottom).
Figure 4.54 GA3 aerial photo pair 8. Image depicts areas north of Riverton where riparian forest has decreased between 1948/49 (top) and 2006 (bottom), in this case at least partially due to agricultural clearing.
Figure 4.5 A 3-repeat photo pair "A" Image (approximately 1940, top and 2008, bottom) depicts the old Chicago and Northwestern Railroad bridge to the left, and a panorama of the levee collection area (note crib left of center). Russian olive and tamarisk are now found amidst cottonwoods and a gravel pit exists to the left of the modern image. Historic image courtesy of Wyoming State Archives.
Figure 4.55 GA3 photo “b” (2009). Image depicts grazed lands, where stands of mature trees display attrition.

Figure 4.56 GA3 photo “c” (2009). Image displays a recently constructed large home sitting next to an irrigation canal, indicative of new cultural preferences and new economies. Note cottonwood trees on the left of the photograph, native to riparian areas, juxtaposed with spruce trees lining the driveway, typical of higher elevation mountainous terrain.
Figure 4.57 GA3 photo “d” (2009). Image looks eastward over Riverton toward the roof of a big box store. Cattle graze in a field dotted with Russian olive, and additional Russian olive trees dominate the panorama in more distant fields.
Point estimates indicate that GA4 (Figure 4.58) experienced a 14 percent decrease in riparian vegetation from the Riverton area to Muskrat Creek, on both tribal and non-tribal lands (Figure 4.59-Figure 4.60). According to point estimates, the number of structures increased 25 percent (Figure 4.61), and took place exclusively on non-tribal lands, with increasing density upstream toward Riverton (Figure 4.62). Specific vegetation patterns, relating to land ownership differences, can be discerned in certain areas. In Figure 4.63 and 4.65, for example, agricultural lands are non-tribally owned.
Figure 4.59 GA4 change in riparian forest. Point estimates indicate a 14 percent decline in riparian forests in GA4.

Figure 4.60 GA4 change in riparian forest with respect to land ownership. Changes in riparian forest took place on tribal and non-tribal lands.
Figure 4.61 GA4 change in development. The number of structures increased with proximity to Riverton.

Figure 4.62 GA4 change in development with respect to ownership. Increases took place exclusively on non-tribal land.
Figure 4.63 GA4 aerial photo pair 1. Image depicts riparian forests north of Riverton, which have decreased between 1948/49 (top) and 2006 (bottom).
Figure 4.64 2006 image from GA4 photo pair 1 (Figure 4.63) depicted with ownership map. Note differences in cultivated and uncultivated land as it corresponds with tribal and non-tribal lands.
Riparian forests are declining visibly in areas (Figure 4.65 and Figure 4.66). In places, Russian olive has almost entirely replaced cottonwoods (Figure 4.67), and tamarisk and Russian olive can be seen growing together (Figure 4.68) alongside willows. Mature cottonwood forests are often composed of mature trees with few understory recruits (Figure 4.69).
Figure 4.65 GA4 aerial photo pair 2. Image indicates that cottonwoods are decreasing in areas more distant from the river between 1948/49 (top) and 2006 (bottom).
Figure 4.66 GA4 aerial photo pair 3. Image depicts declines in riparian forests, and increases in agricultural lands with changes in irrigation technology, in this case a central pivot (1948/1949, top, and 2006, bottom).
Figure 4.67 GA4 aerial photo pair 4. Image depicts areas in which Russian olive has almost completely replaced former cottonwood forest between 1948/49 (top) and 2006 (bottom).
Figure 4.68 GA4 photo “a”. Image depicts Russian olive (dominant in photo), tamarisk (in front of center Russian olive), and willow (foreground, right of tamarisk) growing alongside one another.

Figure 4.69 GA4 photo “b”. Image depicts a stand of narrowleaf cottonwoods displaying attrition, with few understory replacements.
Geographical Area 5

Figure 4.70 Location map of GA5 imagery. Images used in this section are marked 1-3 and a-c. The extent of GA5 is outlined in blue. Aerial photography pairs (1948/49 and 2006) are numbered 1-3 and ground photography a,b,c.

Geographical Area 5 (GA5) (Figure 4.70) is the area affected by Boysen Dam and reservoir, either directly through inundation or indirectly through the upstream effects of inundation (Figure 4.72). Both expansion of human structures and replacement of forests around the reservoir periphery are minimal. Even in the southern end of the geographical area, outside of the area of inundation, development and riparian forest has decreased. Extensive riparian forests were
flooded when Boysen Dam was constructed and completed, in 1952 (Figure 4.72-Figure 4.76).

Figure 4.71 Aerial images of Boysen Dam area, 1948/49 and 2006. Aerial photo pair (1948/49, top, and 2006, bottom) depicts bottomlands flooded when Boysen Dam was completed in 1952.

The current Boysen Dam replaced a much smaller dam, the original Boysen Dam, constructed in 1908 by Asmus Boysen and located at the mouth of the Wind River Canyon (Figure 4.76 and Figure 4.77). During the Pick Sloan dam building era, the second and exponentially larger Boysen Dam was constructed upstream from the smaller dam, which was removed.

Throughout GA5, patches of tamarisk can be found along tributaries and upstream from the reservoir. It is suspected that tamarisk spread from areas where it was used for sediment control, when efforts were made to decrease
erosion from irrigation return flow from the Riverton Project through Fivemile and Muddy Creeks (Fremont County Weed and Pest personal communication 2010). Evidence of Russian olive planting in GA5 also is well documented (Missouri River Basin Field Committee 1954a; Bureau of Indian Affairs Photo Archives, Ft. Washakie).
Figure 4.72 GA5 aerial photo pair 1. Image depicts vegetation changes in the area downstream from Boysen reservoir (1948/49, top, and 2006, bottom). Note agricultural expansion to the West in the 2006 image.
Figure 4.73 GA5 aerial photo pair 2. Image (1948/49, top, and 2006, bottom) depicts bottomlands that were flooded by Boysen reservoir waters in 1952.
Figure 4.74 GA5 aerial photo pair 3. Image (1948/49, top, and 2006, bottom) depicts reservoir waters covering extensive bottomlands when Boysen Dam was completed in 1952.
Figure 4.75 GA5 repeat photo pair “a”. Ground rephotography depicts Boysen reservoir bottomlands prior to 1952 (top) and in 2007 (bottom) in photo pair “a”.
Figure 4.76 GA5 repeat photo pair “b”. Image depicts the original Boysen Dam and reservoir, constructed in 1908 for hydropower (top). The dam has since been removed and surrounding areas turned into Boysen State Park camping areas (bottom). Photos taken prior to 1947 and in 2007.
Figure 4.77 GA5 repeat photo pair “c”. Image depicts the original Boysen Dam, photographed before 1947 (left) and in 2007 (right). The dam has since been removed. The much larger Boysen Dam, located upstream, was constructed in the Pick Sloan era of dam construction.
Summary of Geographical Areas

Point estimates indicate that riparian forest decreased between 10 and 15 percent in geographical locations GA1, GA2, and GA4. The Riverton area (GA3) and the Muskrat Creek to Boysen Reservoir areas (GA5) differed from this range. The main reason for the dramatic decrease in riparian vegetation (56 percent) in GA5 is obvious: Boysen Dam flooded bottomlands. The five percent increase in riparian vegetation in the Riverton area (GA3) is multifaceted; several factors may play roles. First, and most importantly, the proliferation of Russian olive is much more extensive in the Riverton area, and downstream from Riverton (Figure 4.51 and Figure 4.52, for example) than in the western upstream portion of the watershed. Russian olive has populated areas that have remained forest and also expanded into areas that were not formerly forested. Russian olive clearly contributed to increased riparian forest around and below Riverton more significantly than in upstream reaches. Much less significantly, urbanization increased treed areas in some locales (Figure 4.78). Some of these trees are cottonwoods, but are just as likely to be other deciduous trees (Figure 4.56) such as maples or elms.
Figure 4.78 Aerial photo pair of suburban development. In GA3, suburban areas displayed an increase in trees and green areas around new houses (1948/49, top, and 2006, bottom).
With respect to land ownership patterns, point estimates indicated that decreases in riparian forest were relatively similar (four to nine percent) on allotted, tribal and fee lands, and on all tribal lands (six percent). The flooding of Boysen Reservoir lands—following a government taking—contributed to forest decline on withdrawn lands. Changes in riparian forest between 1948/49 and 2006 do not appear to be related to tribal or non-tribal ownership. Changes prior to 1948/49, when agricultural lands were established, may reveal significantly different results. Alienated lands have been much more likely to experience agricultural conversion than tribal and allotted lands (Figure 4.79 and Figure 4.80), resulting in less riparian forest on those lands.
Figure 4.79 Land ownership and its relationship to cultivated lands in GA4. In GA4, agricultural lands tend to disproportionately favor withdrawn and fee lands, or all alienated lands.
Figure 4.80 Land ownership and cultivated lands in GA2. In GA2, allotted lands and tribal lands display less relationship to agricultural lands than do withdrawn and fee lands.
In sum, changes in riparian forest take place indiscriminately across ownership patterns from 1948/49 to 2006; and geographic location is a significant factor in riparian change.

Point estimates suggest that development (as indicated by increased structures) increased one to five percent in both geographic areas west of Riverton and did not increase in the Boysen Reservoir region between 1948-1949 and 2006. In contrast, the Riverton area increased 260 percent and the area north of Riverton increased 25 percent. Both geographic areas immediately surrounding Riverton increased more than geographic areas distant from Riverton. The Riverton urban center played a significant role in the changing settlement corridor and overall Basin growth (Figure 4.47 and Figure 4.48).

Even within the Riverton region, land ownership differences contribute to heterogeneous patterns of change. While allotted lands, tribal lands and withdrawn lands increased between 1 and 8 percent, development on fee lands increased 170 percent. Alienated lands showed over 16 times the rate of increase as all tribal lands (110 percent and 6 percent respectively) (Figure 4.46 and Figure 4.81). Fee lands are most likely to be developed and tribal lands and withdrawn lands are least likely to be developed.
Figure 4.81 Development and land ownership in GA3. The area just south of Riverton (GA3) shows that fee lands displayed dramatically more development than tribal and allotted lands, or all tribal lands.
Conclusion

Prior research suggests that riparian forests are declining in the region for myriad reasons. Some of these undoubtedly relate to Wind River riparian forest declines. Damming and water diversion, water table declines, altered flow patterns, documented historic overgrazing in the early 1900s, agricultural clearing, invasive species (particularly Russian olive, but also tamarisk), and climate change are all potentially relevant forces of change. This study does not attempt to correlate specific changes to decreased riparian forests. Rather, it suggests that riparian change takes place heterogeneously along the Wind River, varying significantly in different geographical areas. Many significant changes are cultural, and differ according to historic factors that have led to the establishment of: 1) different settlement patterns along the river, 2) specific land use policies and ownership patterns and 3) different cultural preferences. Regulations establishing land allotment, tribal lands, and fee lands for example, date from the late 19th and early 20th Centuries. Withdrawn lands relate to two different irrigation eras, the first in the early 1900s, when the Riverton Project was developed, and the second in the 1940s, when riparian bottomlands were flooded and Boysen Dam was constructed. Complex patterns of riparian change are both ecological and social. These social complexities and their relationships to environmental change are significant.

Point estimates suggest that development (as measured by numbers of human structures) is increasing, and is typical of New West trends in which
population growth occurs near protected areas. Growth has been particularly apparent in the GYE. This research suggests that growth is not just related to rural residential development and New West economies; rather, it takes place near Riverton and disproportionately on non-tribal lands.

In sum, the multi-ethnic, historical factors involved in growth and ecosystem change are important in understanding nuances of change and the ways they contribute to the human-environmental dynamics of large ecosystems.
CHAPTER 5

CONCLUSION

This dissertation investigates how unique settlement geographies and place identities relate to environmental change and the way that change is perceived. It examines the physical landscape as a dynamic meeting point of invisible and visible landscapes, where perception and identity interface with ecology. Irish poet and philosopher John O'Donahue says, “The visible world is the first shoreline of the invisible world” and that “the poignancy of being a human being is that you are the place where the invisible becomes visible and expressive in some way” (American Public Media 2009). While he goes on to discuss these points theologically, they can be interpreted geographically: the relationship between unfolding humanity and environment is a metaphorical “shoreline”, a place created by forces more invisible than visible.

Understanding the human-environmental factors involved in environmental change is critical. Alessa et al. (2008) is worth quoting again, “Global environmental change, particularly in water resources, exists as both perceived and measured conditions. Of these two, the former is more powerful” but both are essential, as is an understanding of the historical context of change. Change is inevitably measured over time as alteration in cultural and physical worlds. Only through a combination of historical geography, place perception,
and measured environmental change can we understand the invisible and visible forces that shape the fluctuating shoreline created by humanity and the world.

Through a case study of the Wind River Basin, a culturally and ecologically diverse portion of the GYE, this research examines the Basin through three different lenses: historical geography, place perception, and through measured environmental change. This chapter closes this dissertation by 1) briefly summarizing the conclusions of its three central research themes, 2) exploring the way each theme informs one another, as well as an understanding of the Wind River Basin as a whole, and 3) discussing cultural-ecological relationships in the Wind River Basin in the context of western water and New West geographies.

Three Lenses of Change

Following the introduction, Chapter 2 explores changing geographies of the Wind River Basin during four different time periods (1868-1904, 1906-1938, 1939-1976, and 1977-2010) and through four different themes (boundaries and legal control, population and settlement patterns, land and water use, and an endlessly dynamic environment). It addresses a tension inherent in western water: residents are both joined and divided by a valuable, mobile, and shared resource that fluctuates in supply and is overburdened with demand. Wind River water was the single most important resource in defining early settlement geographies and economies of the Wind River Basin. Yet, as these geographies morphed, Wind River water was transformed. The cultural patterns and power
relationships of new and diverse human geographies, as well as the fluctuations inherent in resource based capitalism influenced the flow of the river. Irrigation withdrawals dramatically reduced river flows, for example, and disproportionately watered non-Native lands; tie drives used Wind River high flows to transform forests to railroad ties while the industry remained profitable. Amidst these transformations, the environment was endlessly dynamic; it adapted unpredictably to human change as, for example, salts accumulated in soils, pests devoured crops, and weeds spread. Many of these changes were mobile, ignored political boundaries and filtered through barbed wire fences. As basin residents responded to these changes, a "hybrid" irrigation landscape developed and dynamically changed with, for example, species introductions and new technologies. Complex cultural-environmental geographies now shape the basin, a "crazy quilt" of hybrid cultural and ecological relationships resulting from a century and a half of change. This spatial textile has been created by the interactions of different cultural groups; power dynamics; different kinds of land ownership governed by different rules, regulations, and legal precedents; informal and formal, contentious and cooperative relationships; fluctuating economies; and a specific environmental setting in the arid west.

Chapter 3 explores perception as a fundamental component of environmental change in the Wind River Basin. Through interviews, it explores various topics through which Basin residents express perceptions of riparian change including the changes in, and cultural geographies of agriculture;
changes in culturally significant plants and perceptions of weeds; climate, irrigation, wildlife regulations, groundwater contamination, litigation and land use change. Its analysis concludes that: 1) perceptions differ culturally, geographically, and between different scales, 2) perceptions represent moral geographies that relate to environmental management conflicts, 3) mobile forms of nature provide particular challenges to shared landscapes and differing perceptions, but non-mobile nature presents challenges too, 4) perceptions exist among complex power dynamics and finally, 5) ecological and cultural resilience may relate to more democratic interactions between cultural groups.

Chapter 4 explores basic physical dimensions of riparian change and their relationships to land ownership in the Wind River settlement corridor. Through analysis of aerial rephotography (1948/49 and 2006) and ground rephotography (various dates), Chapter 4 concludes that riparian forest is decreasing and development is increasing in the study area. Changes in overall riparian forest and development are heterogeneous and relate to both geographical distribution and land ownership geographies. While areas upstream from the Diversion Dam are less affected by Russian olive and tamarisk, for example, areas near and downstream from Riverton, have experienced substantial increases in their distributions; and while the Riverton area has experienced dramatic growth, the Crowheart area has seen little change. With the exception of the Boysen Dam area, land ownership geographies relate more to growth than riparian change. Growth is far more likely to take place on non-tribal lands.
Historical Geography and Environmental Change

Examinations of environmental change in Chapter 4 suggest that decreases in riparian forest and increasing development are geographically heterogeneous. Some of these changes may be attributed to environmental relationships (tamarisk and its tendency to proliferate at lower elevations) but others are clearly linked to historical events (the use of invasive species to stabilize erosive soils). While ecological studies generally try to link specific changes to specific causes, which is a critical component to management concerns, this dissertation does the opposite. It illuminates a mosaic of change, and tries to present the historical and cultural complexity of that change.

Chapter 4 suggests that historical and cultural factors in environmental change have never been singular, just national or just local in scale, or simply the product of different cultural groups occupying different spaces. Changes in flows, for example, are not just the result of the Diversion Dam, or irrigation withdrawals, as is often referenced in perceptions of change; they relate to national policies unfolding in the specific context of the Wind River Basin in the early 1900s. Patterns of growth currently surrounding Riverton cannot just be attributed to the uranium boom or New West geographies. They relate to power dynamics, shifting federal land policies for Indians and non-Indians, cultural preferences, and fluctuating economic markets. Events and policies, and the environmental and cultural responses to them, have created a mosaic of localized and basin-wide change.
Specifically, Chapter 4 finds that riparian forest decreased in four different geographical areas since 1948/49, and increased in one: the area surrounding Riverton. It suggests that riparian change may relate to several factors, some of which include historic and present grazing regimes, river flow alteration, introduction of invasive species, inundation by Boysen Reservoir waters, agricultural clearing, climate change, and others. Likewise, Chapter 4 finds that growth has disproportionately taken place in the area surrounding Riverton, that agriculture is far more likely to take place on non-tribal rather than tribal lands, and that growth patterns differ on tribal and non-tribal lands. All of these factors can be traced to policies and preferences of specific time periods discussed in Chapter 2. Moreover, an understanding of these historical legacies is critical to land management; cultural-ecological relationships are not likely to change unless the social and ecological drivers for those events change. It is not probable, for example, that changes in flows will take place unless climatic conditions change and/or power relationships or local economies shift.

Many aspects of riparian change in the Wind River Basin are not local in scope; they mirror national trends. I offer three examples. 1) Current flow regimes of the Wind River relate to federal Indian policy and Reclamation policy of the early 1900s. These policies supported two kinds of irrigation development, one for ceded Indian lands and one for Indian lands. The surveying and development of western irrigation on ceded Indian lands using Indian water was not unusual. The Riverton Project was one manifestation of this policy which
involved the collaboration of the state and federal government. Its irrigation infrastructure was intended for non-Native settlers, and was surveyed and constructed, at least in part, with Indian funds. The Wind River Irrigation Project served Indian lands and resulted from a different policy: the intent to transform tribes into farmers. Wind River water has been increasingly diverted to serve the irrigation needs of these, and additional, lands throughout the last century. The power dynamics that relate to flow were established in the early 20th Century.

2) The unusual growth patterns surrounding Riverton reflect different settlement patterns according to whether they take place on tribal or non-tribal lands. These differences are in part linked with the fluctuating federal Indian policy of two different eras. First, the Indian Allotment policy (1868-1936) transformed Indian lands to individually owned private property, which could be sold from native to non-Native ownership. Second, the later Indian Reorganization Act era (1934-1953) returned available ceded lands to tribes and prevented allotted lands from being sold. The result of the two eras is a pattern of checker-boarded native and non-Native lands; non-Native lands can be subdivided and sold, allotted Native lands cannot. Moreover, accumulating numbers of heirs on tribal lands limit development options. Power dynamics were, and are, a central part of these policies. The town of Riverton, for example, was platted and backed by state officials; courts are currently debating whether it should have been reclassified as tribal lands when the allotment era passed.
3) The inundation of Wind River riparian lands with Boysen Reservoir waters is a result of the Pick-Sloan era of new Indian land grabs (beginning in 1944), which transformed a disproportionate amount of Missouri River Basin tribal lands to reservoirs, one of which was Boysen Dam. These waves of federally-mandated Indian policy and irrigation policy, when combined, left permanent geographical fingerprints on tribal lands, and their river basins in the West. The policies were not unique to this place.

Other influences of change along the Wind River have been local, and unique. I offer three examples. 1) The tribes’ enduring communalism created unique geographies. Since 1939, the tribes have jointly managed grazing on vast tracts of tribal lands, and under the Tribal Game Code of 1984 manage reservation hunting and fishing in Wind River waters. Their policies differ from elsewhere in the state and leave unique environmental fingerprints. Though they manage lands together through decisions of a Joint Tribal Council, aspects of the tribes are distinct. Eastern Shoshone and Northern Arapaho settlement geographies along the Wind River differ from those of non-Native residents. Eastern Shoshones originally settled on the westernmost portion of the reservation and Northern Arapahos in the east, a legacy that remains from the late 1800s. All along the river, but particularly in community centers, tribal lands display different settlement preferences from non-Native geographies: tribal members tend to settle in family groups and settlement is dispersed. In contrast, non-Native settlement, particularly in community centers, is more regularly
segmented in individually owned parcels. 2) Tribal lands are less likely to be
cultivated than non-Tribal lands. While capital and infrastructure contributes to
this difference, the tribes have always expressed far more interest in ranching
than farming, despite decades of pressure from the federal government. Cultural
preferences shape Wind River geographies. 3) The preferences of individuals
and families influence local geographies. While Lloyd Dechert, for example,
specializes in high end alfalfa hay in the Riverton Project, his neighbors grow
beans and beets and new amenity buyers may not farm at all. Likewise, near
Crowheart, the Nature Conservancy is bordered by tribal lands, allotted lands,
and fee lands. Each owner, whether individual or communal, manages according
to different principles and preferences.

The power dynamics inherent in historical events have played a critical
role in environmental change. The vastly greater investment by the federal
government in non-tribal over tribal irrigation projects; the “geographies of
exclusion” and “economies of detail” that tribal members navigated, particularly in
the early 1900s; and the inability of the tribes to assert their flow preferences in
the Wind River have environmental consequences. The tribes certainly asserted
control in their own way, but did so from positions of political and economic
disadvantage. Like environmental legacies, legacies of power are continuous.
Sauder (2009) opens his book on the Yuma Irrigation Project with a quote from
Navajo chairman Peterson Zah, “When I was a kid in geography class, I was
taught that water always flows downhill. What I’ve learned since is that water
flows to money and power, wherever they may be.” In the Wind River Basin, and all over the West, water flows toward power (Worster 1985) and has since the basin’s first irrigation surveys in 1902. Its environmental fingerprint is visible.

Despite the many ways people alter the environment through federal policies or the informal daily preferences of individuals, the environment has never been and never will be, entirely “managed” in the Wind River Basin or anywhere else. Unintended consequences of human changes have elicited more human change, “hybrid landscapes” of human-environmental interactions, and endless adaptation. Comparative photographs of the 1940s and 2000s will change again in the next 60 years, perhaps because of climate change, perhaps because of economic oscillations, or shifting local preferences. History suggests that the interactions between the environment and its people are difficult to predict.

**Perception and Environmental Change**

Chapter 4 focuses on two main research questions: 1) have riparian forests decreased over the last sixty years, and is this decrease homogeneous over different geographical areas and different ownership patterns, and 2) is rural development changing the settlement corridor and is it transforming land homogeneously? Its conclusions closely correspond with many perceptions of change in Chapter 3. However, observations of local residents offer far more detailed information than remote sensing methods, and remote sensing observations record broader trends in landscape change. Perceptions, unlike
scientific data, align change with "moral geographies". Their understanding of their ecosystem is not mechanical. Individuals are not concerned with how things work, but rather, whether change corresponds with “the right way to be.”

The conclusions of Chapter 4 and expressions of basin residents in Chapter 3 generally correspond. Chapter 4 analyses conclude that riparian forests are decreasing in all portions of the study area, except the Riverton area, where they are increasing, mainly because of Russian olive proliferation. While interviewees do not always agree on reasons for change, several tribal members, Fish and Game Staff, and Fremont County Weed and Pest staff all observe the spread of invasive Russian olive and decline of cottonwoods in lower portions of the basin. Basin residents in the upper portion of the basin express almost no concern for cottonwood decline, Russian olive proliferation, and less development. These observations correspond with examinations of aerial photographs. While cottonwood forests do appear to be declining in the upper basin, and development increasing slightly, these changes are less pronounced than in the lower basin. Residents of the Riverton area unequivocally report concerns with invasive species, and more development and land subdivision on the north side of the river. These observations also correspond with results from aerial photography analysis.

Basin residents describe very particular observations of change not visible in aerial photography. For example, Ralph U. and Ben W. describe Morton Lake as an area of climatic shift; it represents the freezeline that defines the area in
which farmers are able to grow row crops. Many tribal members observed a decrease in culturally significant plants including berry bushes, yellow root, wild carrots, and wild onions. They notice a decrease in cottonwoods and willows, overall, but specifically plains cottonwoods. Referring to plains cottonwoods, Iva R. says:

Can't find them anymore. They're dying. They're dying. They're seeing that the ones that everybody's allergic to are coming up, those narrowleaf instead of the wide. They [tribal members] prefer the big ones [plains cottonwood] because it doesn't give off that... pollen that's on the narrowleaf. It kind of bothers them. They prefer the big but they're starting to see the narrowleaf taking over.

Sherry B. recalls the area around her childhood swimming hole, which was called "One Tree" after an enormous plains cottonwood, and recalls, "It does seem like they're not as plentiful as they used to be when I was a kid...I never realized it, but now that I think about it, I don't think there's as many [plains cottonwoods] as there used to be when I was growing up." She notices narrowleaf cottonwood, "but no great big cottonwoods, just those narrowleaf," at the swimming hole.

Local observations include site-specific information and broader observations of change. The Susquehanna site, for example, which many cite as the greatest riparian concern for the tribes due to its radioactive contamination, is discernable only as an industrial structure that appears in later aerial photographs. Tribal members hold specific information on this area, noting the existence of certain contaminants in swimming holes and berry collecting areas as well as their potential health consequences. Observations of climate change are more broadly expressed. Ralph U. remembers driving a Model T, carrying a
piano, over the ice covered Wind River. He says, “We haven’t had that for 20 or 30 years. It always froze up solid. You could drive across it anywhere. Not anymore.” John W. remembers, “The winter of 1949, it was cold. I mean it was cold. Cows were freezing standing up in the fields. You never hear of that now.”

In addition to individual observations, environmental perceptions elicit cumulative cultural knowledge, gathered over time. Its most revealing form is in language itself. The Arapaho word for wild rose, for example (wáhXu:-ya:no) translates as “elk-berries” and the Shoshone word for sweet grass (bah, soe·ree"p) is “water, wild hay”. Descriptive environmental relationships are maintained through cumulative cultural knowledge, particularly in language and its structure. These relationships are not discernable through objective remote observation.

In contrast to site specific, localized cultural knowledge, aerial comparison (in Chapter 4) provides more objective measures of environmental change not discernable through local knowledge. Rather than reporting change in certain areas, these methods make it possible to observe large scale change over time and visually compare different areas. In aerial photography, for example, it is possible to estimate overall change in the Basin and compare differences in geographical areas. These observations are particularly relevant in sparsely occupied areas. For example, aerial imagery reveals that the Boysen Reservoir flooded a substantial amount of riparian bottomlands, and was likely the greatest single event affecting riparian change in the basin. However, the Boysen Project
was not mentioned by basin residents as a factor in riparian change. Few people occupied the Boysen area, and localized knowledge does not reflect this change. Additionally, aerial imagery records gradual changes that may not be discernable through ground observation. Changes in the upper basin may be more apparent in photographs, because change occurred gradually, not instantaneously, over time. Slower effects of climate change, or long-term consequences of grazing, for example, may be more visible in aerial imagery than on the ground.

Like images of the earth from satellites, science serves a purpose; it offers information from a more objective view. Yet science tells a story from its own political context, and is never entirely objective. It is a product of value systems, funding sources, and political imperatives; it is not value free. Localized cultural knowledge and scientific knowledge should not be dichotomized. They are both methods of assessing change, and at best, are complementary. They can test one another for bias, and provide a more comprehensive view of change. Together, various interpretations of change inform a moral reality: what should the world look like? What is the right way to be?

**Historical Geography and Perception**

Historical geography and place perception, when combined, offer perhaps the most interesting relationship between this dissertation’s three themes. They together offer a broader understanding of the invisible landscape and the reasons it shapes the visible landscape in particular ways. Historical geography explores unfolding events over time. It examines the way power dynamics and
flows of capital move through a place and leave specific environmental footprints. Place perception adds another dimension to this discussion by investigating the way these events are interpreted.

Individual events, and the patterns of local history have cumulatively shaped the “moral imagination” of Wind River Basin residents, but not homogeneously. Basin residents tell different histories and interpret them in different ways. For example, many residents believe irrigated agriculture has been one of the single largest factors in change along the Wind River, but they also hold polar views. Ralph U. believes it was the single best change, and Geoff O. cites it as the single worst. Likewise, Lloyd D., who cultivates Riverton Project lands says, “This land needs to be tilled. If not it looks like what you saw when you come over the hill. Looks like sagebrush. And what’s that good for? It’s good for sage grouse and a few other things. It’s a good riparian area, but what’s it for? Antelope? But to make a living off of it and supply food for the world, it’s not gonna happen.” In contrast, Berthenia C. flat out says, “I think this is the wrong place to try to grow crops” and Richard B. says:

I’m hoping that people will realize that water has to be managed more efficiently and that leaving water in the river is probably more important than taking water out of the river. When you really look at agriculture in the Wind River Basin, agriculture is a non-paying proposition. You can’t justify the amount of water that they’re using to put on the land to grow what they’re growing. You can’t justify that. It’s not economical...I think people are starting to realize that the philosophy the tribes have of water, and using water, and the importance of water to all life is a much better viewpoint than looking at it from one or two uses, particularly agricultural uses.
Place perception is selective. It uses historical patterns that support a particular view, and is in no way comprehensive. For example, when discussing the extensive Big Horn litigation, Reba Teran says:

They made us abide by the treaty, but they didn’t have to... We have to use our water for agriculture and nothing else. We could have an electrical plant, a water plant, even a recreation area, like a reservoir... We could have all that, because we’re first water users, but we’re not allowed to... It’s not fair. You know, we have that right: the Bighorn decree. We have the rights but we’re not allowed to do anything.

Reba T. speaks more to her interpretations of patterns of justice than exact historical events. The “treaty” and the water litigation are two events, separated by decades, but expressed as one “wrong”.

Perception of change, with respect to a place, expresses what is “right” and how a place should be. It tends to be In Basso’s words (1996):

...accepted as natural, normal, and unexceptional...and, having grown to mature proportions, stoutly resistant to change. Its complex affinities are more an expression of community involvement than they are of pure geography, and its social and moral force may reach sacramental proportions, especially when fused with prominent elements of personal and ethnic identity (148).

Power dynamics between perceptions are a strong, invisible force of landscape transformation. Historical geography helps us understand those power dynamics in place, and how and why those perceptions came to be.

Historical Geography, Place Perception, and Environmental Change:

Together, the three themes of this dissertation portray the Wind River Basin as a place where the environment is changing. Riparian forest is declining
and development is increasing; but change is complex, not related to one single factor or era. There are no clear distinctions between “ecological systems” and “human systems” and “coupled human and natural systems” implies something far more mechanical than hybrid and dynamic (National Science Foundation 2010). The physical landscape of the Wind River corridor is the visible edge of relationship. Its ecosystem is a product of its location on Earth and its ecological processes but also its cumulative human history and the impression it has left on the human imagination. The shape of the Wind River corridor is a “shoreline”, the dynamic product of an endless motion where humans and their surroundings continue to interact with one another and establish, and reestablish, a particular place.

Managing a River: The Wind River and Water in the West

Donald Worster writes, “Quite simply, the modern canal, unlike a river, is not an ecosystem. It is simplified, abstracted Water, rigidly separated from the earth and firmly directed to raise food, fill pipes, and make money” (Worster 1985, 5). Likewise, Ellen Wohl suggests river restoration projects should strive to establish the “reference condition” of a river, or the state of a river prior to human influence. Dichotomizing humans and nature in this way does more than create a “moral schizophrenia” (Cronon 1991, 384) separating us from the economic relationships and power relationships in which we take part (Harris 1991; Harris 1997). It portrays water abstractly; its highest state is untouched. More Biblical than practical, dichotomizing humans and nature promotes its own moral
geography in which there is actually a right way to manage a river system, albeit impossible.

An ecosystem is not separate from the people who live in it. And an “ideal” river is not just shaped by ecological and geomorphic, *namely visible*, processes. Places are uniquely shaped by a complex combination of historical geographies, perceptions, and environmental processes and must be managed in the context of complexity.

Nancy Langston unravels this complexity when she discusses the history of the Malheur Wildlife Refuge (2003). “Managers become dangerous when they close themselves off from challenges to orthodoxy and when they use the power of the state to enforce their vision on human and ecological communities,” she writes (160). She points out that when preservationists took control, they created an “empire of nature” no more ecologically superior or inferior than prior management regimes (116). Langston promotes three elements of pragmatism in adaptive management of ecosystems, “concern with evolutionary adaptations in a changing environment; interest in the scientific method as a process for understanding that changing world; and concern with pluralism, multiple voices, and the formation of democratic communities.” Because “the natural world always escapes our stories about it” (156) we should incorporate as many perspectives as possible, equally, and manage with humility. Democratic processes may play additional roles in management practices. Alessa et al. (2008) suggest that the way environmental change is perceived is critical to
people’s willingness to respond to change. If change goes unnoticed, it may accumulate to a detrimental threshold, impacting a community and/or resource.

The Wind River has never been managed democratically. It has been the borderline of shifting policies and perceptions, caught in a tangle of push and pull from various sides. The Basin is one of the most culturally diverse areas of the GYE, and people hold a variety of perceptions on the river and how it should be. Managing these diverse perspectives democratically may not create a pristine river or establish reference conditions, but it may create an environment where the change perceived by various groups is perceived by all, where moral geographies are forced to acknowledge different perspectives, where fisheries and irrigation are not mutually exclusive, where legal fees contribute to the basin directly, where power between cultural groups is shared.

The Wind River is an ecosystem, and like any other, composed of the complex interactions of its physical environment and human dynamics, which evolve together as one ecosystem.

New West Trends

This dissertation opens by placing the Wind River in the southeastern portion of the Greater Yellowstone Ecosystem. The GYE boundary is the latest of many, drawn with an academic interest and conservation pen. The Wind River, and most of its basin residents, is very likely unaware of the GYE, and its position in it.
Current GYE discussions focus on New West concerns: population growth and development surrounding ecosystem boundaries threatens ecosystem function. Gude et al. (2006), for example, found a 58 percent increase in population of the GYE between 1970 and 1999 and a 350 percent increase in rural residential development. Conservationists fear that rural growth may impact ecosystem processes (such as disturbances like fire, or processes such as species migrations).

This study of the Wind River suggests that patterns of growth are complex and heterogeneous, even within one river basin. Moreover, habitat change within riparian areas relates to a variety of factors that correlate much more with historical events than New West trends. Ecosystem changes, including current growth patterns may not just relate to current economic trends, they may relate to deep rooted cultural preferences, land ownership patterns established early last century, and fluctuating flows of capital, which have always been responsible for dramatic ecosystem change; they are not new.

Environmental studies of Greater Yellowstone increasingly include people as a part, and not separate, from the ecosystem. They acknowledge that effective land management requires an understanding of social and ecological process and the way these interact to shape place. These studies are imperative in managing such an environmentally and socially complex ecosystem, yet they are incomplete.
Modest measurements of ecosystem size estimate that The Greater Yellowstone Ecosystem spans 20 million acres, or 31,250 square miles (Big Sky Institute 2010); jurisdictional boundaries, or county boundaries, (used in this dissertation) estimate 145,635 km, or over 90,000 square miles (Gude, Hansen, and Jones 2007). These estimates suggest that Greater Yellowstone ranks somewhere between the size of South Carolina and the size of Minnesota in area. Any area of such size is inevitably socially complicated, rich in history, and culturally diverse. Moreover, in summer 2009, almost 2.3 million people visited Yellowstone National Park alone (National Park Service 2009), which is over four times the resident population of Wyoming, over twice the population of Montana, and 800,000 more than the population of Idaho. The total population of Idaho, Wyoming, and Montana combined is just over three million (U.S. Census Bureau 2009a). Seasonally, socially, and ecologically, Greater Yellowstone is complex and unique.

The Wind River Indian Reservation highlights the need for ecosystem management dialogues that are as complex as the ecosystem itself. The reservation is roughly the size of Yellowstone National Park, yet Yellowstone’s summer visitation is one hundred times the reservation’s population of 23,250 (U.S. Census Bureau 2009b). The reservation is a critical, yet overlooked, component of the ecosystem. It is not just essential to ecosystem management because it happens to be within ecosystem boundaries. Its cultural values and settlement history are central to why it has retained wildlands and wildlife. For
example, the tribes designated 180,387 acres of its reservation as a “National Roadless Area” in 1938, twenty six years before the Wilderness Act was passed (Wind River Environmental Quality Commission 2010). Development has strategically been limited to the plains. Moreover, tribal boundaries supercede county boundaries; reservation water rights are federal reserve; the tribes manage their own fish, game, forestry, and range. The tribes maintain exclusive control over the vast majority of their reservation as communally owned “tribal lands” and, as such, are a powerful entity with respect to questions of conservation and ecosystem change. Their particular history and management preferences make it possible, for example, for the tribes to consider reintroduction of free roaming bison herds (Baldes 2009) independent of the state.

Effective ecosystem management must take into consideration the nuances of tribal lands, but not just tribal lands. This oversight is indicative of rarely discussed social complexity throughout the ecosystem, not just on reservation lands. Robbins et al’s (2009) questions concerning the New West are worth repeating: “the empirical question may not be do newcomers and old timers differ?” but instead ‘what cultural-economic differences exist among the residents of dynamic exurban spaces, and what processes produce, maintain, or erode those cultures and differences?’” and not “‘what are the relative merits of local versus non-local control?’” but also ‘at what scales do power and decision making converge, and what determines or constructs the ‘appropriate’ scale for
decision making under divisive political conditions?” This study proposes additional questions. Building upon valuable studies that assess the impacts of current economic trends on ecosystem function, what economic patterns establish the flows of capital and what are the environmental implications of these patterns? Building upon studies that identify regional hotspots and ecosystem vulnerabilities, what are the historical legacies and cultural preferences that shape current environmental trends and create vulnerabilities? The addition of more historical and multiethnic investigations in ecosystem questioning promises to transform the perception of the GYE into an ecosystem where social and ecological systems are equally complex and intertwined. The boundaries of the GYE encompass an area where people have lived for over a century in a capitalist economy shaped by cultural and ecological diversity and resilience. History is continuous; its policies, economies, and diverse peoples—though often forgotten in the lens of the present—still play vital roles in environmental change.
CLARIFICATION OF RESERVATION BOUNDARY AND JURISDICTION OF LANDS NORTH OF THE WIND RIVER

This addendum has been added to correct an error involving the exterior boundary of the Wind River Indian Reservation in this dissertation. The following discussion clarifies this complex legal issue.

This dissertation occasionally depicts current Reservation boundaries as excluding the Riverton Irrigation withdrawal (see Figure 1.2, 1.5, 2.29, 2.39). It additionally uses language that suggests the 1905 Act of March 3, 1905 “diminished” the reservation, implying that lands on the north side of the river fell from tribal jurisdiction (see “Bridges in a Divided Basin: 1906-1938” and “Sharing the Basin: 1939-1976”). This addendum wishes to both clarify that these lands remained under tribal jurisdiction, and to represent the tribal perspective on this matter, which was not made explicit in this dissertation.

The Statement of Legal Counsel Regarding the Tribes’ Authority to Regulate Air Quality (December 17, 2008) outlines why the Eastern Shoshone and Northern Arapaho tribes believe lands on the north side of the Wind River remain under tribal jurisdiction.

First, as discussed in this dissertation, many reservation lands encompass fee lands, or non-tribally owned lands, such as those lands included in the Riverton Project. These lands legally remain under tribal jurisdiction unless it is
found that Congress intentionally diminished the reservation to exclude them. The Wind River Tribes maintain that in the 1905 Act (Second McLaughlin Agreement of 1904 in this dissertation) Congress did not intend to exclude these lands from the reservation, since “Congress did not expect immediate, or for that matter full, settlement of the opened Reservation lands” (17). If Congress had intended to exclude these lands, it would have treated them as public domain lands, which it did not (57). Lands north of the Wind River have been repeatedly recognized legally as under tribal jurisdiction, including—for example—in matters regarding rail rights-of-way across Indian lands (21), grazing leases (24), O and M charges on ditches to the north of the Wind River (27), and through Indian appropriations used for the development of the Riverton Project (as described in this dissertation). The Tribes conclude that the 1905 Act concerning lands on the north side of the Wind River held land in trust status for the tribes and proceeds for sold lands were to be used for their benefit. Thus, the government’s intent was not to diminish the reservation. Rather, “Once a block of land is set aside for an Indian reservation and no matter what happens to the title of individual plots within the area, the entire block retains its reservation status until Congress explicitly indicates otherwise” (from Solem v. Bartlett, 465 U.S. 463, 470, 1984).

Second, a 1953 Act of Congress (67 Stat 592) provided approximately one million dollars to compensate the Tribes for a) lands taken unlawfully for the development of the Riverton Project, and b) funds related to roads, reservoirs, and other developments which had taken place on unsold tribal lands. A new
boundary was drawn around Riverton Project lands—encompassing 225,000 acres—and the remaining lands were returned to the tribes. A later 1958 Act (72 Stat. 935) clarified that the tribes maintained mineral rights to lands within the project area, recognizing tribal jurisdiction.

Third, The Big Horn litigations clarified that lands north of the river that were not “disestablished or patented to non-Indians” maintained an 1868 priority date, and supported tribal jurisdiction of these lands.

The Tribes thus conclude that the reservation encompasses 2,268,000 acres, including the city of Riverton and the Riverton Project.

Thus, this addendum emphasizes two misrepresentations in this dissertation:

1) Maps such as those depicted in Figure 1.2, 1.5, 2.29, 2.39 are incorrect, and should more accurately be represented by Figure 2.40:
2) Any discussion that implies a “hole” in the reservation, or indicates that the Riverton Irrigation withdrawal is non-tribal land should be held in question. Confusion over this issue is not anomalous. For example, a 2012 Associated Press article (Denver Post, March 8) on mineral issues near Pavillion suggests that “Much of the area, including Pavillion, is on land surrounded on three sides by the Wind River Indian Reservation, at least according to maps that reflect land deeds from over a century ago.” Yet the article also suggests that the tribes “maintain that the area is part of the reservation.” Perhaps land owner John Fenton expresses the most common perception that jurisdiction over his land is a “grey area.”
It is with regret that—in trying to address “geographies of exclusions” in the American West, that this dissertation has mistakenly excluded a viewpoint of the tribes. The confusion itself elucidates this dissertation’s own point: the convoluted, complex ownership histories of tribal and non-tribal lands are difficult to untangle, even with the intent of taking great care to recognize all sides.
REFERENCES CITED


Bureau of Reclamation. 1925. Project History, Riverton Project. IX

———. 1926. Project History, Riverton Project. IX.

———. 1937. Project History, Riverton Project. XXII.


———. 1915c. Letter from F. H. Mondell to the Commissioner of Indian Affairs, "Dry Creek Bench Ditch". In RG 75. Denver, Colorado: National Archives.


Park County Planning Board. 2006. Park County, Montana growth policy.


*Treaty with the Shoshonees and Bannacks*. 40th Congress, August 12, 1868. 15 Stat 673.


APPENDIX A

INTERVIEW QUESTIONS
Semi-directive interviews were designed to stimulate discussions of change as perceived by interviewees. Their intent was to encourage interviewees to express their perceptions through their own expertise. Interview questions focused on three themes:

1) **Assessing perception of present vegetation landscape**

   **Objective:** to assess knowledge of current ecology and ecological relationships, and to understand the way different species are valued.

   **Questions:**
   a) Identify plants of value to you that grow in this area (e.g. native plants, crops, weeds).
   b) Identify plants that are not of value to you.
   c) Explain the reasons you value these plants.
   d) Under what conditions do these plants grow?

2) **Assessing perception of present cultural landscape**

   **Objective:** to understand perceptions of land ownership and land management of Wind River riparian areas, and perception of self and other in ecological relationships.

   **Questions:**
   a) Are there differences in land management along the Wind River?
   b) If so, who manages lands of concern to you?
   c) If so, how do these differences relate to the way you perceive change?
   d) Where do you think land is managed best and why?

3) **Assessing perception of social/ecological change**

   **Objective:** To understand how ecological change is interpreted and valued over time

   **Questions:**
   a) What are the three most major changes in Wind River riparian areas over the past 50 and past 100 years?
   b) What are the three worst things that have taken place over the past 50 and past 100 years?
c) What are the most positive things that have happened over the past 50 and past 100 years?

d) What would an ideal state of this river look like?

e) What will the river become in 50 more years? 100 years?

f) What should the river become in 50 more years? 100 years?