

# MAJOR IN WATERSHED SCIENCE AND SUSTAINABILITY, WATERSHED SCIENCE CONCENTRATION

The Watershed Science concentration focuses on the physical, chemical, social, and biological factors that affect the quantity, quality, and flux of water through engagement in the field, laboratory, and classroom. Students begin their program with core courses that build a strong foundation in the physical and natural sciences in preparation for upper-division coursework in land use and snow hydrology, land use and water quality, and watershed problem analysis. Courses emphasize field learning and technical skills, with core classes emphasizing watershed measurements, data analysis, modeling, and research. Students graduating in the watershed science concentration will qualify for federal hydrology jobs under the Office of Personnel Management series 1315.

## Learning Outcomes

Students will be able to:

- Articulate core concepts in watershed science and sustainability including climate processes, surface and subsurface hydrology, water quality, human uses of water, and sustainable water management.
- Describe how different types of land and water use affect hydrologic processes and water quality.
- Collect, analyze, and interpret meteorological, hydrological, and water quality, water use and management data.
- Analyze watershed problems and sustainability challenges using geospatial data, field observations, sensor data, and watershed models.
- Demonstrate strong critical thinking, writing, and oral communication skills.

## Requirements Effective Fall 2022

### Freshman

		AUCC	Credits
CO 150	College Composition (GT-CO2)	1A	3
ESS 120	Intro to Ecosystem and Watershed Sciences		1
ESS 129	Information Management for Sustainability		1
STAT 158	Introduction to R Programming		1
WR 204/GR 204	Sustainable Watersheds (GT-SC2)	3A	3
Select 4 credits from the following:			4
BZ 110 & BZ 111	Principles of Animal Biology (GT-SC2)	3A	
BZ 120	Principles of Plant Biology (GT-SC1)	3A	
Select one group from the following:			5
Group A:			
CHEM 107	Fundamentals of Chemistry (GT-SC2)	3A	
CHEM 108	Fundamentals of Chemistry Laboratory (GT-SC1)	3A	
Group B:			
CHEM 111	General Chemistry I (GT-SC2)	3A	
CHEM 112	General Chemistry Lab I (GT-SC1)	3A	
Select one course from the following:			3-4
ESS 210/GR 210	Physical Geography		
GEOL 110	Introduction to Geology-Parks and Monuments (GT-SC2)	3A	
GEOL 120	Exploring Earth - Physical Geology (GT-SC2)	3A	
GEOL 122	The Blue Planet - Geology of Our Environment (GT-SC2)	3A	
GEOL 124	Geology of Natural Resources (GT-SC2)	3A	
GEOL 150	Physical Geology for Scientists and Engineers	3A	
Diversity, Equity, and Inclusion ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#diversity-equity-inclusion">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#diversity-equity-inclusion</a> )		1C	3
Social and Behavioral Sciences ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#social-behavioral-sciences">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#social-behavioral-sciences</a> )		3C	3
<b>Total Credits</b>			<b>27-28</b>

### Sophomore

LIFE 320	Ecology		3
----------	---------	--	---

2 Major in Watershed Science and Sustainability, Watershed Science Concentration

MATH 155 or 160	Calculus for Biological Scientists I (GT-MA1) Calculus for Physical Scientists I (GT-MA1)	1B	4
MATH 161 or 255	Calculus for Physical Scientists II (GT-MA1) Calculus for Biological Scientists II	1B	4
SOCR 240	Introductory Soil Science		4
STAT 301 or 315	Introduction to Applied Statistical Methods Intro to Theory and Practice of Statistics		3
Select one group from the following:			10
Group A:			
PH 121	General Physics I (GT-SC1)	3A	
PH 122	General Physics II (GT-SC1)	3A	
Group B:			
PH 141	Physics for Scientists and Engineers I (GT-SC1)	3A	
PH 142	Physics for Scientists and Engineers II (GT-SC1)	3A	
Arts and Humanities ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities</a> )		3B	3
<b>Total Credits</b>			<b>31</b>
<b>Summer</b>			
NR 220	Natural Resource Ecology and Measurements		5
<b>Total Credits</b>			<b>5</b>
<b>Junior</b>			
AREC 342	Water Law, Policy, and Institutions		3
NR 322	Intro. to Geographic Information Systems		4
WR 416	Land Use Hydrology	4B	3
WR 418	Land Use and Water Quality		3
WR 474	Snow Hydrology		3
WR 486	Watershed Field Practicum		2
Select one course from the following:			2
CO 301B	Writing in the Disciplines: Sciences (GT-CO3)	2	
JTC 300	Strategic Writing and Communication (GT-CO3)	2	
LB 300	Specialized Professional Writing	2	
Arts and Humanities ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities</a> )		3B	3
Electives			6
<b>Total Credits</b>			<b>30</b>
<b>Senior</b>			
WR 417	Watershed Measurements		3
WR 440	Watershed Problem Analysis	4A,4B,4C	3
Select one from the following:			4
GEOL 452	Hydrogeology		
SOCR 470 & SOCR 471	Soil Physics		
Select one course from the following:			3
BZ 471	Stream Biology and Ecology		
ESS 474	Limnology		
Watershed Science Department List (see list below)			6
Historical Perspectives ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives</a> )		3D	3

Electives<sup>1</sup>

4-5

**Total Credits****26-27****Program Total Credits:****120****Watershed Science Department List**

Select a minimum of 6 credits from courses not taken elsewhere in the program. Additional coursework may be required due to prerequisites.

Code	Title	Credits
AREC 311	Agricultural and Resource Product Marketing	3
AREC 340/ECON 340	Introduction-Economics of Natural Resources	3
AREC 375	Agricultural Law	3
AREC 442	Water Resource Economics	3
ATS 350	Introduction to Weather and Climate	2
ATS 351	Introduction to Weather and Climate Lab	1
BSPM 445	Aquatic Insects	4
BZ 440	Plant Physiology	3
BZ 441	Plant Physiology Laboratory	2
BZ 471	Stream Biology and Ecology	3
BZ 472	Stream Biology and Ecology Laboratory	1
CHEM 334	Quantitative Analysis Laboratory	1
CHEM 335	Introduction to Analytical Chemistry	3
CHEM 338	Environmental Chemistry	3
CIVE 322	Basic Hydrology	3
CIVE 330	Ecological Engineering	3
CIVE 413	Environmental River Mechanics	3
CIVE 423	Groundwater Engineering	3
CIVE 425	Soil and Water Engineering	3
CIVE 440	Nonpoint Source Pollution	3
ERHS 448	Environmental Contaminants	3
ESS 311	Ecosystem Ecology	3
ESS 312	Sustainability Science	3
ESS 353	Global Change Impacts, Adaptation, Mitigation	3
ESS 365	Global Climate Justice	3
ESS 400	Global Perspectives on Sustainability	3
ESS 471	Special Topics in Ecosystem Sustainability	1-6
ESS 474	Limnology	3
F 311	Forest Ecology	3
F 324	Fire Effects and Adaptations	3
FW 300	Biology and Diversity of Fishes	2
FW 301	Ichthyology Laboratory	1
GEOL 446	Environmental Geology	3
GEOL 452	Hydrogeology	4
GEOL 454	Geomorphology	4
GEOL 551	Groundwater Modeling	3
GEOL 552	Advanced Topics in Hydrogeology	2-3
GEOL 553	Use of Tracers in Hydrogeology	3
GEOL 554	Remote Sensing of the Earth System	3
GES 440	Sea Level Rise and a Sustainable Future	3
GES 450	Global Sustainability and Health	3

GES 470	Applications of Environmental Sustainability	3
GR 320	Cultural Geography	3
GR 330	Urban Geography	3
GR 331	Geography of Farming Systems	3
GR 333	Glaciers and Climate Change	3
GR 345	Geography of Hazards	3
GR 348	Biogeography	3
GR 410	Climate Change: Science, Policy, Implications	3
GRAD 592	Water Resources Seminar	1
NR 310	Ecosystem Services and Human Well-Being	3
NR 320	Natural Resources History and Policy	3
NR 323/GR 323	Remote Sensing and Image Interpretation	3
NR 330	Human Dimensions in Natural Resources	3
NR 365	Environmental Education	3
NR 370	Coastal Environmental Ecology	3
NR 375	Environment and Natural Resources Leadership	1
NR 400	Public Communication in Natural Resources	3
NR 422	GIS Applications in Natural Resource Management	4
NR 425	Natural Resource Policy and Sustainability	3
NR 450	Geospatial Project Design and Analysis	4
NRRT 330	Social Aspects of Natural Resource Management	3
NRRT 362	Environmental Conflict Management	3
RS 478	Ecological Restoration	3
SOC 322	Environmental Justice	3
SOC 323	Soc. of Environmental Cooperation & Conflict	3
SOC 461	Water and Social Justice	3
SOC 463	Sociology of Disaster	3
SOCR 322	Principles of Microclimatology	3
SOCR 370	Irrigation Principles	2
SOCR 371	Irrigation of Field Crops	1
SOCR 375	Soil Biogeochemistry	3
SOCR 440	Pedology	4
SOCR 500	Environmental Measurement Laboratory	1
WR 406	Seasonal Snow Environments	3
WR 492	Seminar	3
WR 575	Snow Hydrology Field Methods	1

<sup>1</sup> Select enough elective credits to bring the program total to a minimum of 120 credits, of which at least 42 must be upper-division (300- to 400-level).

## Major Completion Map

courses (MATH 117, MATH 118, MATH 124, MATH 125, MATH 126) prior to the courses listed in this plan.

**Distinctive Requirements for Degree Program:** This program assumes that students will either test out of or take the prerequisite Mathematics

### Freshman

Semester 1		Critical	Recommended	AUCC	Credits
CO 150	College Composition (GT-CO2)	X		1A	3
ESS 120	Intro to Ecosystem and Watershed Sciences	X			1
ESS 129	Information Management for Sustainability	X			1
WR 204/GR 204	Sustainable Watersheds (GT-SC2)	X		3A	3
Select one group from the following:		X			5
Group A					
CHEM 107	Fundamentals of Chemistry (GT-SC2)			3A	
CHEM 108	Fundamentals of Chemistry Laboratory (GT-SC1)			3A	
Group B					
CHEM 111	General Chemistry I (GT-SC2)			3A	
CHEM 112	General Chemistry Lab I (GT-SC1)			3A	

**Total Credits** **13**

Semester 2		Critical	Recommended	AUCC	Credits
STAT 158	Introduction to R Programming	X			1
Select one course from the following:		X			3-4
ESS 210/ GR 210	Physical Geography				
GEOL 110	Introduction to Geology-Parks and Monuments (GT-SC2)			3A	
GEOL 120	Exploring Earth - Physical Geology (GT-SC2)			3A	
GEOL 122	The Blue Planet - Geology of Our Environment (GT-SC2)			3A	
GEOL 124	Geology of Natural Resources (GT-SC2)			3A	
GEOL 150	Physical Geology for Scientists and Engineers			3A	
Select 4 credits from the following:		X			4
BZ 120	Principles of Plant Biology (GT-SC1)			3A	
BZ 110 & BZ 111	Principles of Animal Biology (GT-SC2)			3A	
Diversity, Equity, and Inclusion ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#diversity-equity-inclusion">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#diversity-equity-inclusion</a> )		X		1C	3
Social and Behavioral Sciences ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#social-behavioral-sciences">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#social-behavioral-sciences</a> )			X	3C	3
CO 150 requirement must be completed by the end of Semester 2.		X			

**Total Credits** **14-15**

### Sophomore

Semester 3		Critical	Recommended	AUCC	Credits
MATH 155 or 160	Calculus for Biological Scientists I (GT-MA1) Calculus for Physical Scientists I (GT-MA1)	X		1B	4
PH 121 or 141	General Physics I (GT-SC1) Physics for Scientists and Engineers I (GT-SC1)			3A	5
SOCR 240	Introductory Soil Science				4
Arts and Humanities ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities</a> )			X	3B	3

**Total Credits** **16**

Semester 4		Critical	Recommended	AUCC	Credits
LIFE 320	Ecology				3
MATH 161 or 255	Calculus for Physical Scientists II (GT-MA1) Calculus for Biological Scientists II	X		1B	4

PH 122 or 142	General Physics II (GT-SC1) Physics for Scientists and Engineers II (GT-SC1)	X		3A	5
STAT 301 or 315	Introduction to Applied Statistical Methods Intro to Theory and Practice of Statistics	X			3
WR 204/GR 204 must be completed by the end of Semester 4.		X			
<b>Total Credits</b>					<b>15</b>
<b>Semester 5</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
NR 220	Natural Resource Ecology and Measurements	X			5
<b>Total Credits</b>					<b>5</b>
<i>Junior</i>					
<b>Semester 6</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
NR 322	Intro. to Geographic Information Systems	X			4
WR 416	Land Use Hydrology	X		4B	3
WR 474	Snow Hydrology	X			3
WR 486	Watershed Field Practicum	X			2
Electives			X		3
<b>Total Credits</b>					<b>15</b>
<b>Semester 7</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
AREC 342	Water Law, Policy, and Institutions	X			3
WR 418	Land Use and Water Quality	X			3
Select one course from the following:		X			3
CO 301B	Writing in the Disciplines: Sciences (GT-CO3)			2	
JTC 300	Strategic Writing and Communication (GT-CO3)			2	
LB 300	Specialized Professional Writing			2	
Arts and Humanities ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities</a> )			X	3B	3
Electives			X		3
<b>Total Credits</b>					<b>15</b>
<i>Senior</i>					
<b>Semester 8</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
WR 417	Watershed Measurements	X			3
Select one from the following:		X			4
GEOL 452	Hydrogeology				
SOCR 470 & SOCR 471	Soil Physics				
Select one course from the following:		X			3
BZ 471	Stream Biology and Ecology				
ESS 474	Limnology				
Watershed Science Elective (See list on requirements tab.)			X		3
<b>Total Credits</b>					<b>13</b>
<b>Semester 9</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
WR 440	Watershed Problem Analysis	X		4A,4B,4C	3
Historical Perspectives ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives</a> )		X		3D	3
Watershed Science Elective (See list on requirements tab.)		X			3
Electives		X			4-5
The benchmark courses for the 9th semester are the remaining courses in the entire program of study.		X			
<b>Total Credits</b>					<b>13-14</b>
<b>Program Total Credits:</b>					<b>120</b>