

# MAJOR IN WATERSHED SCIENCE AND SUSTAINABILITY, WATERSHED DATA CONCENTRATION

The Watershed Data concentration focuses on fusing data science skills and techniques with deep knowledge of the physical, chemical, social, and biological factors that affect the quantity and quality of water as it moves through ecosystems. Students will engage in field, laboratory, and classroom research in both watershed and data science courses, and graduate with a Minor in Applied Data Science in addition to their major. The program starts with students taking core foundational physical and mathematical courses that build towards an understanding of how to use watershed data to better understand watershed function and management. Core classes emphasize watershed science, data analysis, data science techniques, and combining these skills for dynamic research and reporting.

## 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.
- Apply data science techniques to spatial and temporal datasets to address watershed and water resource problems.
- 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
CS 150B	Culture and Coding: Python (GT-AH3)	3B	3
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 course from the following:			4
CHEM 107	Fundamentals of Chemistry (GT-SC2)	3A	
CHEM 111	General Chemistry I (GT-SC2)	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	
Select one course from the following:			4
MATH 155	Calculus for Biological Scientists I (GT-MA1)	1B	
MATH 160	Calculus for Physical Scientists I (GT-MA1)	1B	
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> )			3
Electives			3
<b>Total Credits</b>			<b>31-32</b>

### Sophomore

CS 220	Discrete Structures and their Applications		4
DSCI 369	Linear Algebra for Data Science		4
NR 322	Intro. to Geographic Information Systems		4
SOCR 240	Introductory Soil Science		4

Select one course from the following:			5
PH 121	General Physics I (GT-SC1)	3A	
PH 141	Physics for Scientists and Engineers I (GT-SC1)	3A	
Select one course from the following:			3
STAT 301	Introduction to Applied Statistical Methods		
STAT 315	Intro to Theory and Practice of Statistics		
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
Electives			3
<b>Total Credits</b>			<b>30</b>
<b>Summer</b>			
NR 220	Natural Resource Ecology and Measurements		5
<b>Total Credits</b>			<b>5</b>
<b>Junior</b>			
<b>Summer</b>			
AREC 342	Water Law, Policy, and Institutions		3
DSCI 335	Inferential Reasoning in Data Analysis		3
STAT 341	Statistical Data Analysis I		3
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:			3
CO 301B	Writing in the Disciplines: Sciences (GT-CO3)	2	
JTC 300	Strategic Writing and Communication (GT-CO3)	2	
Watershed Science Department List (see list below)			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> )		3D	3
<b>Total Credits</b>			<b>29</b>
<b>Senior</b>			
WR 417	Watershed Measurements		3
WR 440	Watershed Problem Analysis	4A,4B,4C	3
Data Science Electives (see list below)			3
Watershed Science Department List (see list below)			6
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 <sup>1,2</sup>			6-7
<b>Total Credits</b>			<b>24-25</b>
<b>Program Total Credits:</b>			<b>120</b>

### Data Science Elective List

Select a minimum of 3 credits from courses not taken elsewhere in the program. Additional coursework may be required due to prerequisites.

Code	Title	Credits			
AREC 335/ECON 335	Introduction to Econometrics	3	ERHS 430	Human Disease and the Environment	3
BZ 346	Population and Evolutionary Genetics	3	ESS 330	Quantitative Reasoning for Ecosystem Science	3
BZ 350	Molecular and General Genetics	4	F 321	Forest Biometry	3
BZ 425	Conservation and Population Genomics	3	FW 370	Design of Fish and Wildlife Projects	3
CS 345	Machine Learning Foundations and Practice	3	FW 401	Fishery Science	3
ERHS 332	Principles of Epidemiology	3	FW 455	Principles of Conservation Biology	3
			FW 469	Conservation and Management of Large Mammals	3
			FW 475	Conservation Decision Making	3
			GEOL 454	Geomorphology	4
			HDFS 350	Applied Research Methods	3

MKT 410	Marketing Research	3
NR 421	Natural Resources Sampling	3
PSY 250	Research Design and Analysis I	3
PSY 350	Research Design and Analysis II	3
RS 432	Rangeland Measurements and Monitoring	2
SOWK 300	Research in Applied Professions	3
STAT 305	Sampling Techniques	3
STAT 342	Statistical Data Analysis II	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
GES 470	Applications of Environmental Sustainability	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 370	Coastal Environmental Ecology	3
NR 422	GIS Applications in Natural Resource Management	4
NRRT 330	Social Aspects of Natural Resource Management	3
NRRT 362	Environmental Conflict Management	3
RS 478	Ecological Restoration	3
SOC 461	Water and Social Justice	3
SOCR 322	Principles of Microclimatology	3
SOCR 370	Irrigation Principles	2
SOCR 371	Irrigation of Field Crops	1
SOCR 440	Pedology	4
SOCR 500	Environmental Measurement Laboratory	1
WR 406	Seasonal Snow Environments	3
WR 492	Seminar	1-18
WR 575	Snow Hydrology Field Methods	1

## Watershed Science Department List

Select a minimum of 9 credits from courses not taken elsewhere in the program. Additional coursework may be required due to prerequisites.

Code	Title	Credits
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 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

<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).

<sup>2</sup> Completion of this major may satisfy requirements for a minor. Contact a Watershed Science advisor for more information.

## Major Completion Map

**Distinctive Requirements for Degree Program:** This program assumes that students will either test out of or take the prerequisite Mathematics courses (MATH 117, MATH 118, MATH 124, MATH 125, MATH 126) prior to the courses listed in this plan.

### Freshman

#### Semester 1

CHEM 107 or 111	Fundamentals of Chemistry (GT-SC2) General Chemistry I (GT-SC2)	X	3A	4
CO 150	College Composition (GT-CO2)	X	1A	3
MATH 155 or 160	Calculus for Biological Scientists I (GT-MA1) Calculus for Physical Scientists I (GT-MA1)	X	1B	4
WR 204/GR 204	Sustainable Watersheds (GT-SC2)	X	3A	3

#### Total Credits

14

#### Semester 2

CS 150B	Culture and Coding: Python (GT-AH3)		3B	3
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#### Critical

#### Recommended

#### AUCC

#### Credits

3B

3

STAT 158	Introduction to R Programming	X			1
Select 4 credits from the following:		X			4
BZ 110 & BZ 111	Principles of Animal Biology (GT-SC2)			3A	
BZ 120	Principles of Plant Biology (GT-SC1)			3A	
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	
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
Electives			X		3
<b>Total Credits</b>					<b>17-18</b>
<b>Sophomore</b>					
<b>Semester 3</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
CS 220	Discrete Structures and their Applications				4
PH 121 or 141	General Physics I (GT-SC1) Physics for Scientists and Engineers I (GT-SC1)	X		3A	5
STAT 301 or 315	Introduction to Applied Statistical Methods Intro to Theory and Practice of Statistics	X			3
Electives			X		3
<b>Total Credits</b>					<b>15</b>
<b>Semester 4</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
DSCI 369	Linear Algebra for Data Science	X		3C	4
NR 322	Intro. to Geographic Information Systems	X			4
SOCR 240	Introductory Soil Science	X			4
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
WR 204/GR 204 must be completed by the end of Semes		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>
<b>Junior</b>					
<b>Semester 6</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
STAT 341	Statistical Data Analysis I	X			3
WR 416	Land Use Hydrology	X		4B	3
WR 474	Snow Hydrology	X			3
WR 486	Watershed Field Practicum	X			2
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	
<b>Total Credits</b>					<b>14</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
DSCI 335	Inferential Reasoning in Data Analysis	X			3
WR 418	Land Use and Water Quality	X			3

Watershed Science Department List (see list on Concentration Requirements tab)			X		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		3
<b>Total Credits</b>					<b>15</b>
<b>Senior</b>					
<b>Semester 8</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
WR 417	Watershed Measurements	X			3
Data Science Electives (see list on Concentration Requirements tab)					3
Watershed Science Department List (see list on Concentration Requirements tab)					3
Electives					3-4
<b>Total Credits</b>					<b>12-13</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
Watershed Science Department List (see list on Concentration Requirements tab)					3
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> )					3
Electives					3
The benchmark courses for the 9th semester are the remaining courses in the entire program of study.					
<b>Total Credits</b>					<b>12</b>
<b>Program Total Credits:</b>					<b>120</b>